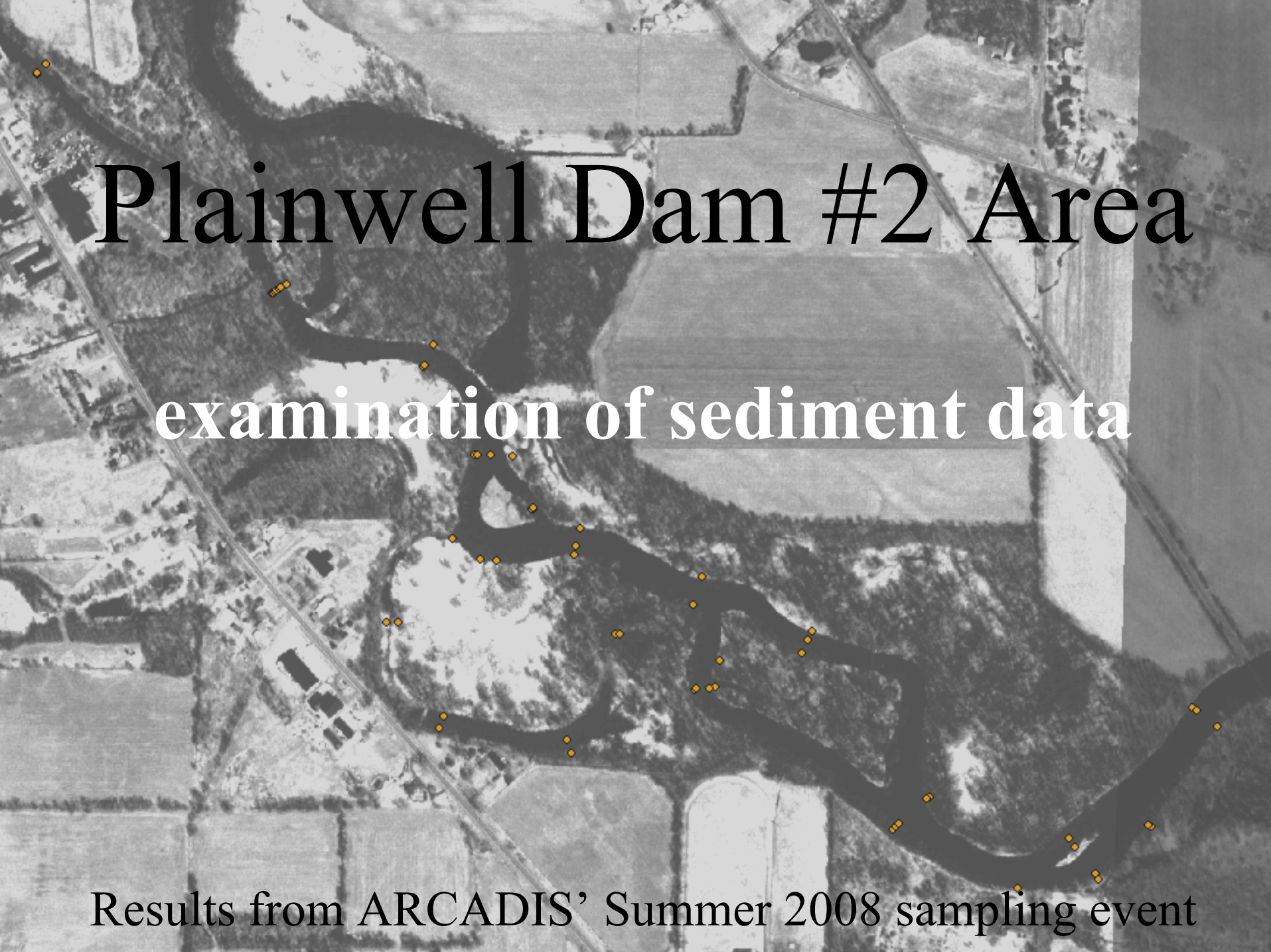


Plainwell Dam #2 Area

examination of sediment data

Results from ARCADIS' Summer 2008 sampling event

Sediment data for Total PCBs

Overview of the following slides:

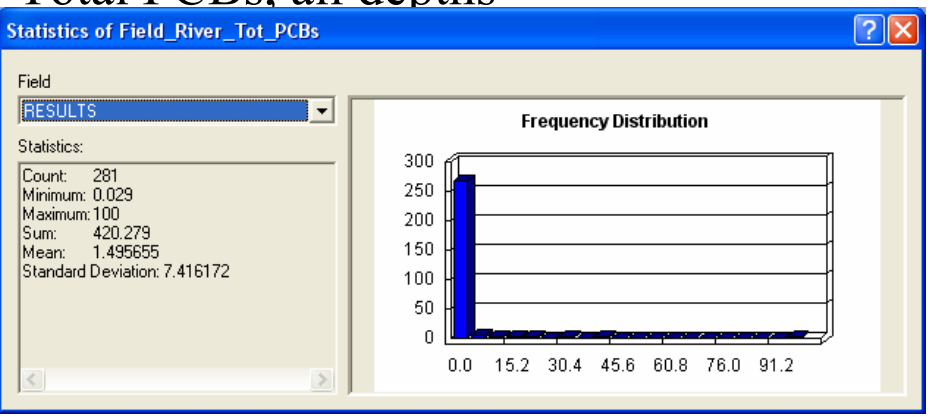
- concentrations of sediment PCBs by depth interval;
- maps of sediment PCBs by depth interval;
- examination of sediment PCBs in the oxbow and effects of removing these PCBs on the concentrations in the rest of the sediment;
- statistical demonstration of clustered (grouped) high PCBs in the oxbow;
- removal of the very high PCBs in the two cores at the entrance of the oxbow leads to no longer having a cluster of high values in the oxbow; and
- mass and volumes of PCBs that would be removed if a forty-foot reach out were used as in the Plainwell impoundment.

Sediment data for Total PCBs

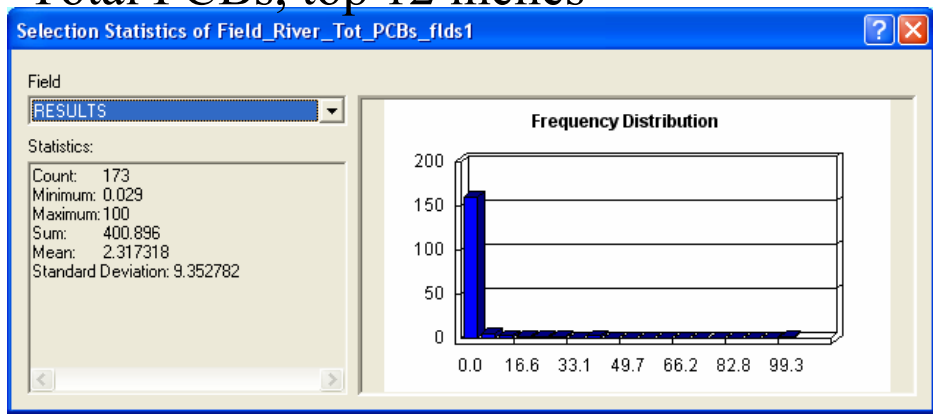
Descriptive Statistics

- 47 of 281 sediment samples analyzed (~17%) have Total PCBs >= 1.0 that are somewhat uniformly spread over the sampling area, although the higher values are concentrated in the oxbow to the southwest

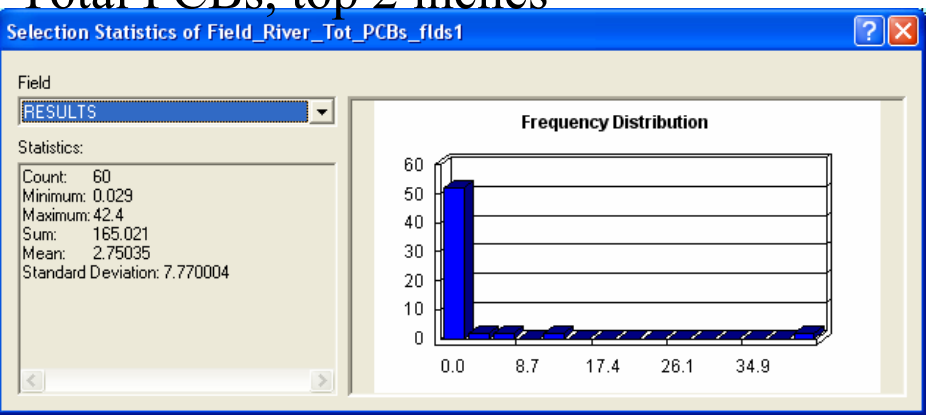
Total PCBs, all depths



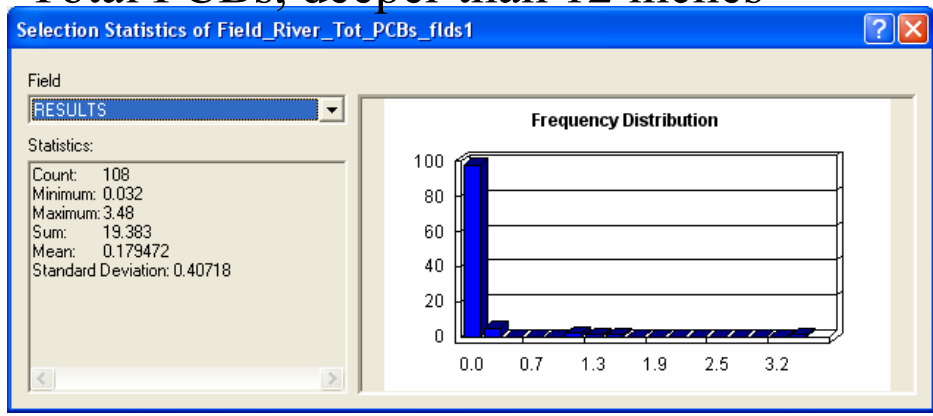
Total PCBs, top 12 inches



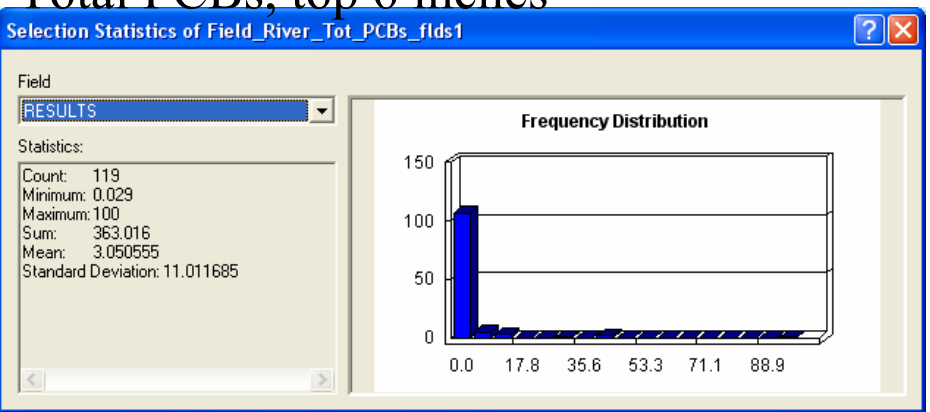
Total PCBs, top 2 inches



Total PCBs, deeper than 12 inches



Total PCBs, top 6 inches

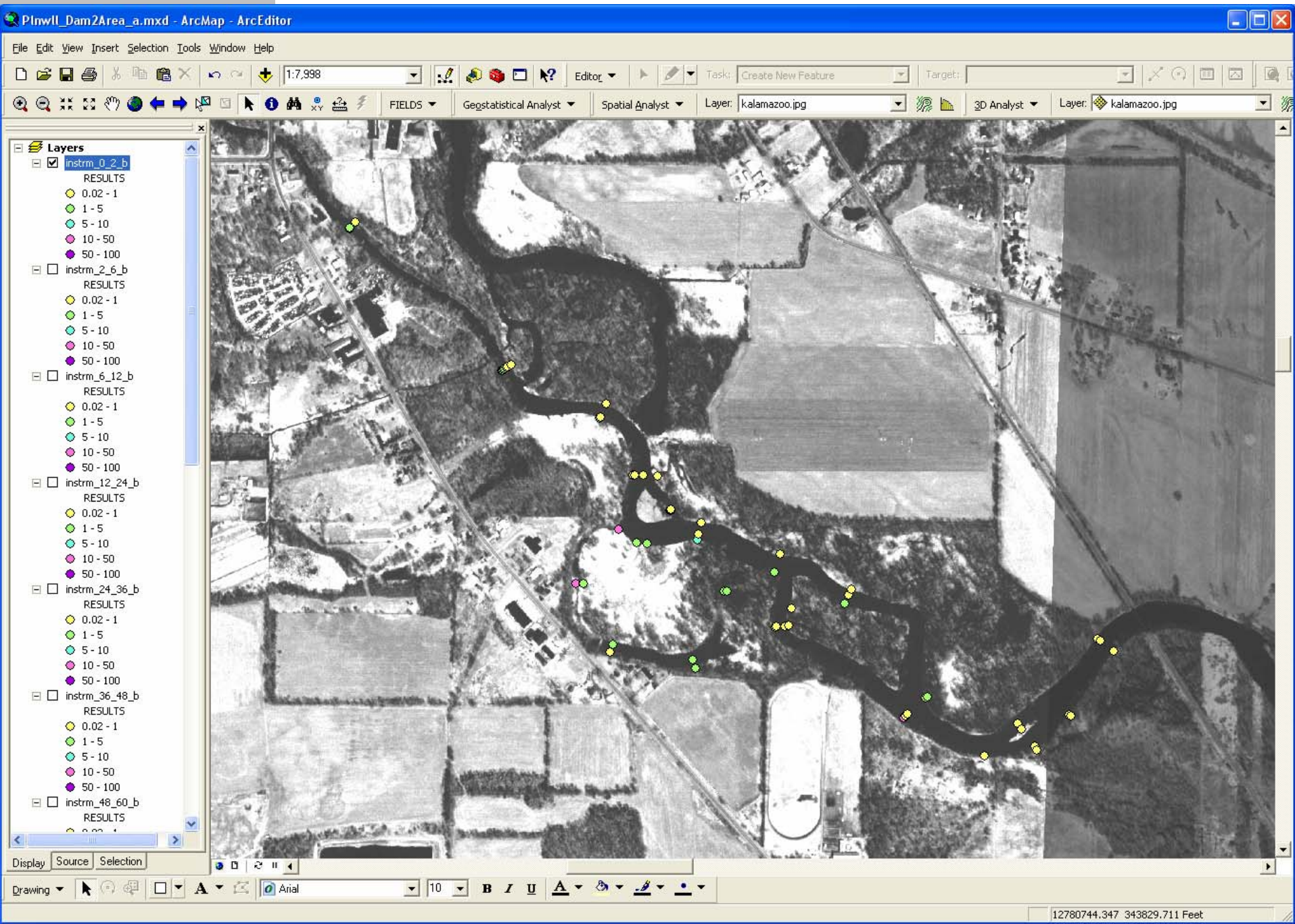


Sediment data for Total PCBs

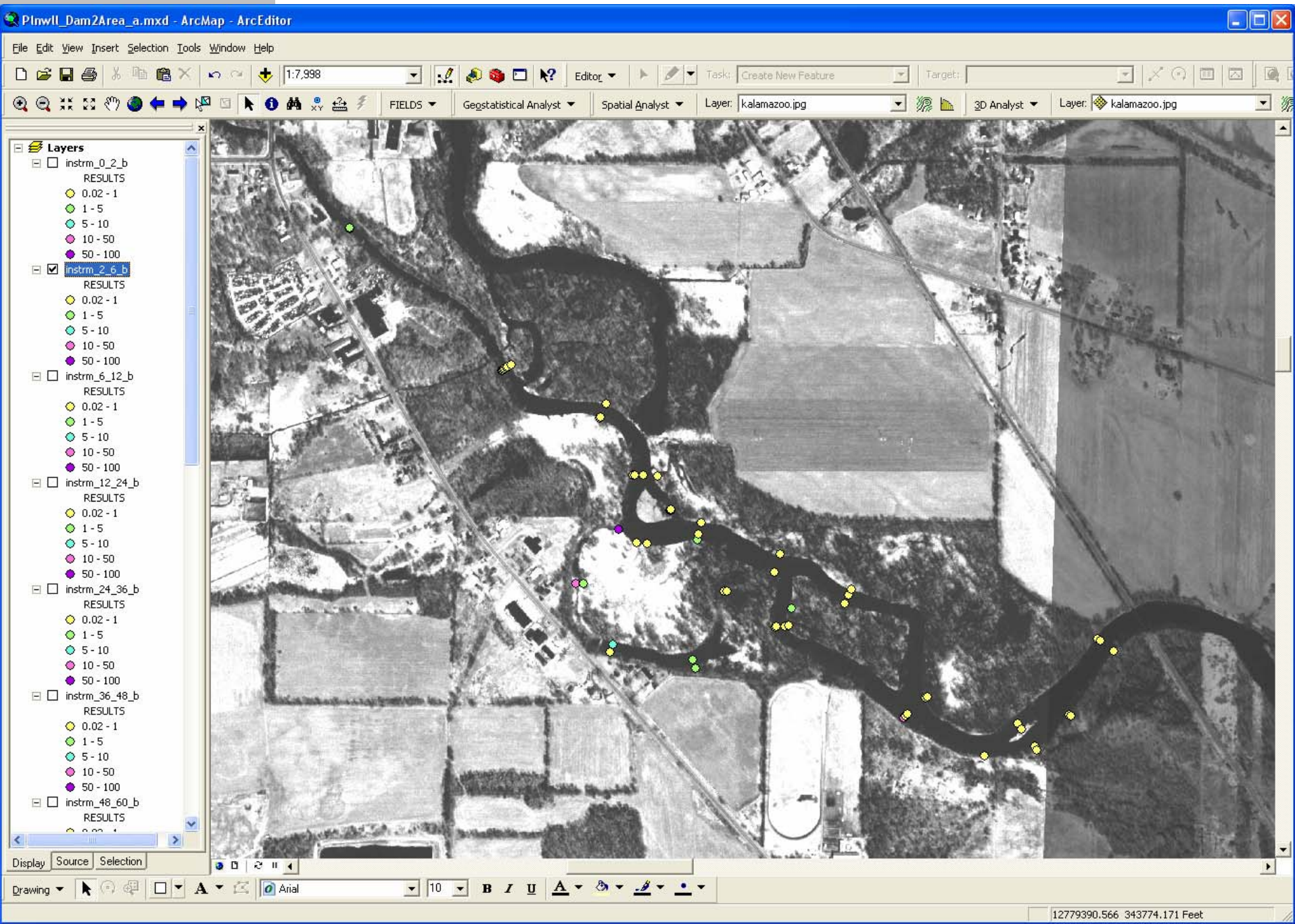
Data Posting (maps) of Depth-Weighted Average (DWA) Total PCBs by interval

- see following slides

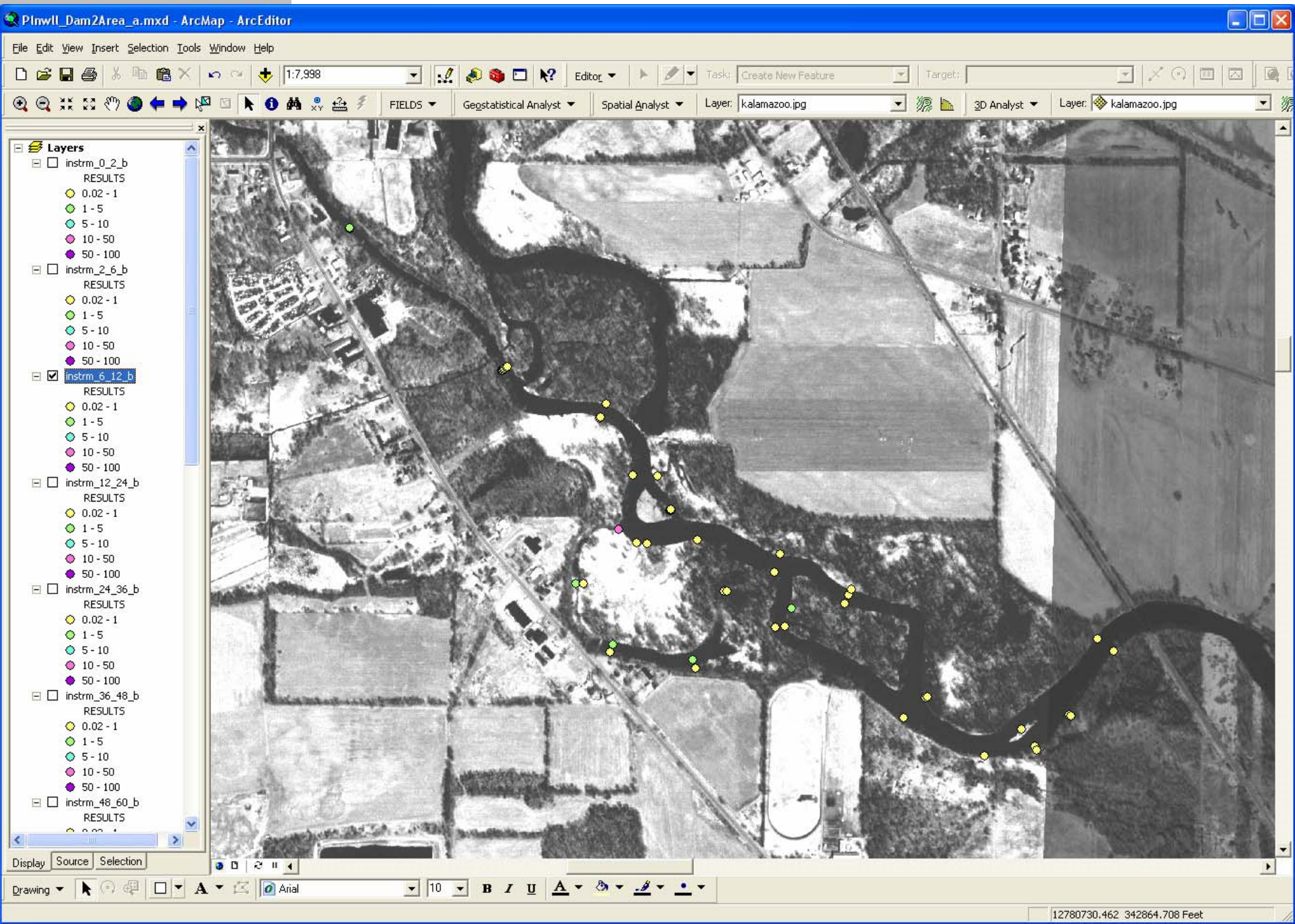
0-2” DWA interval



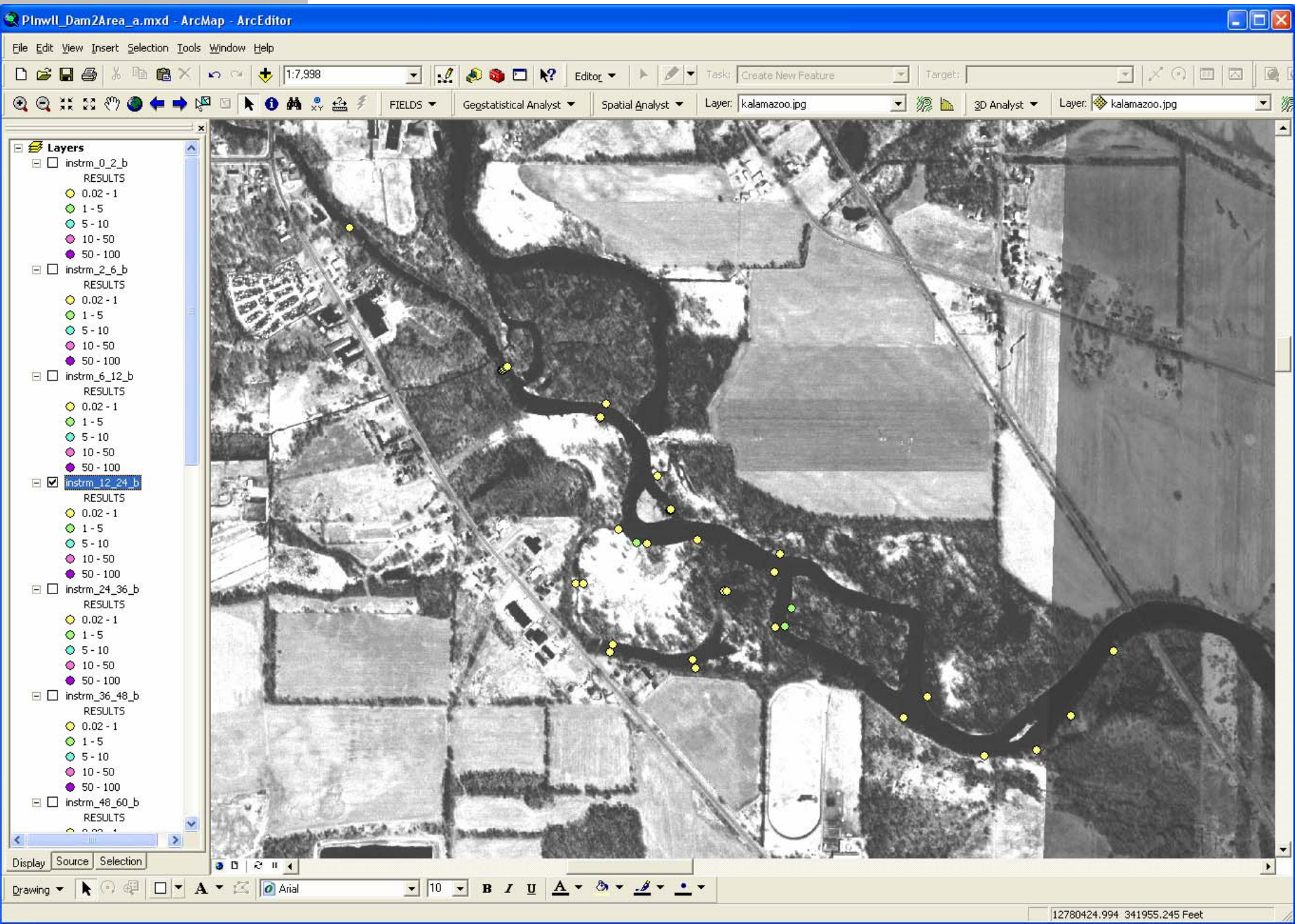
2-6” DWA interval



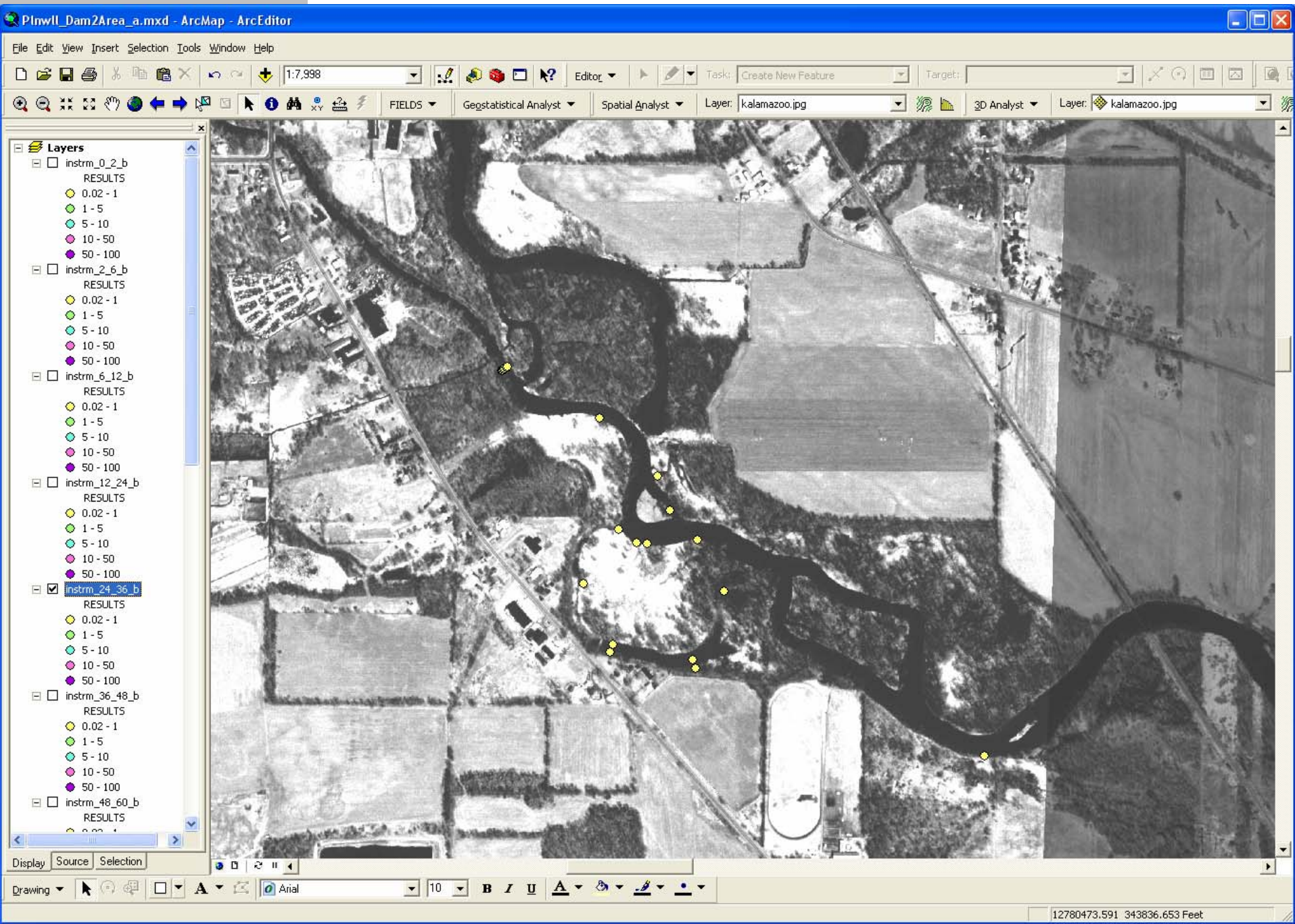
6-12” DWA interval



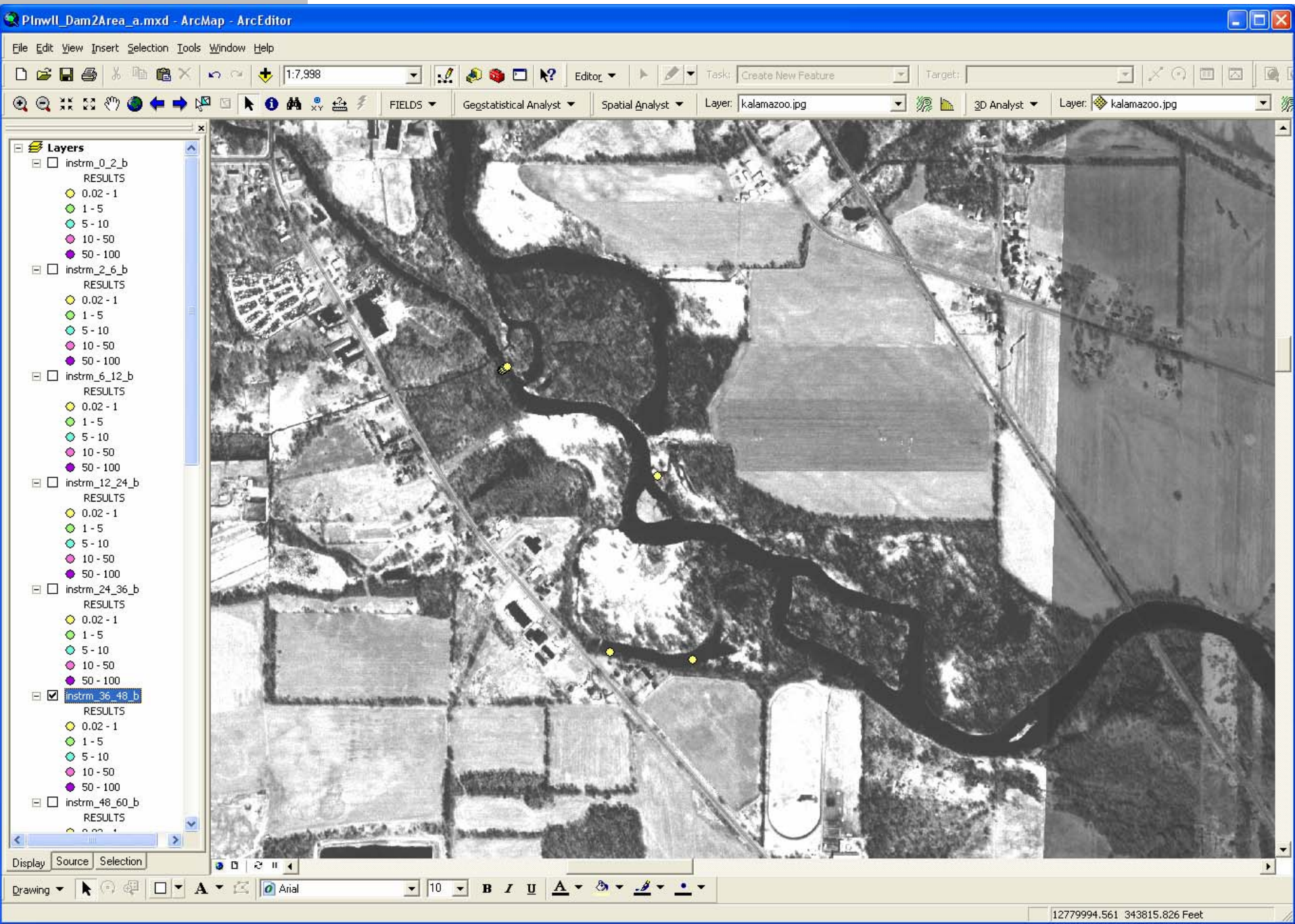
12-24” DWA interval



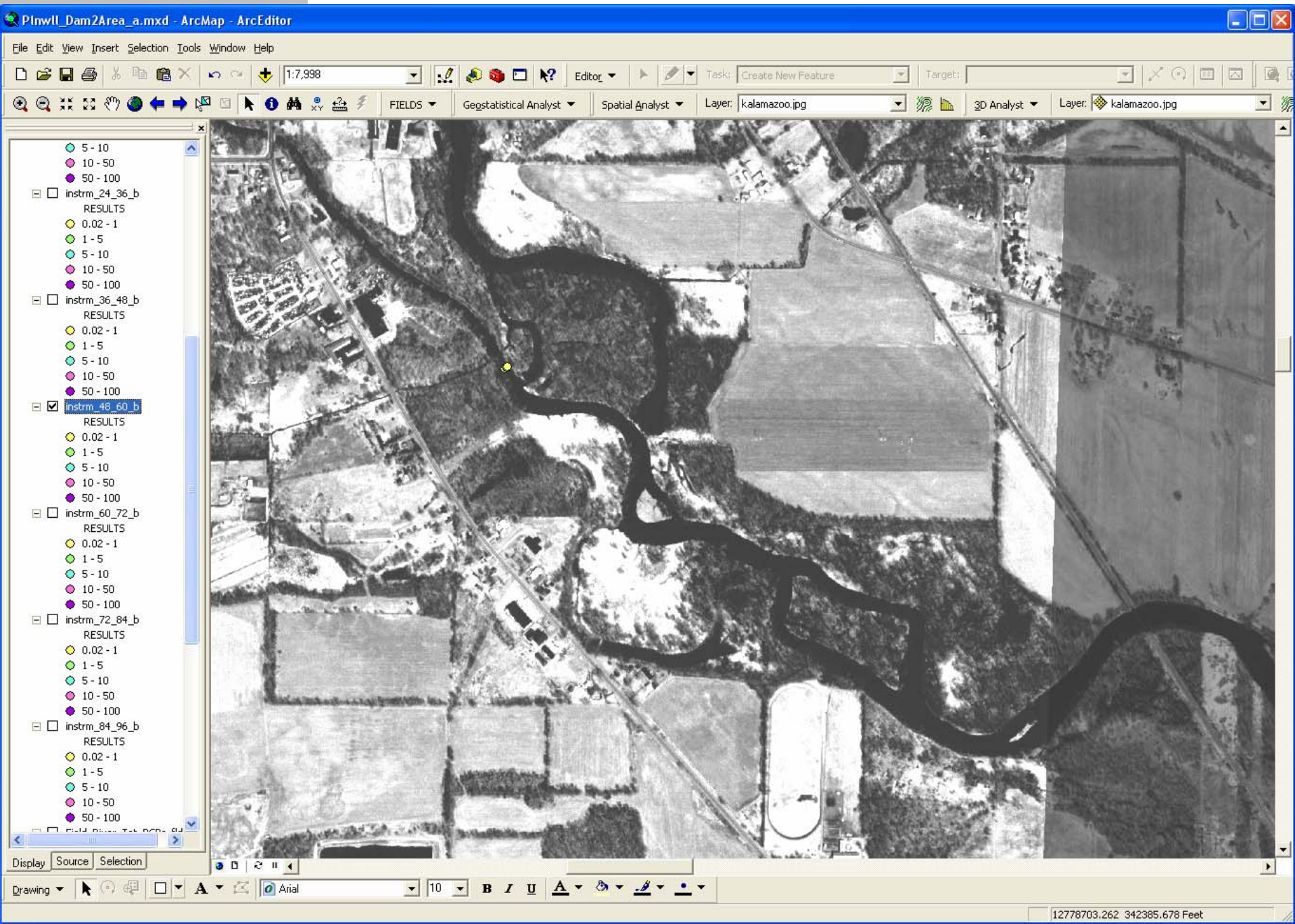
24-36” DWA interval



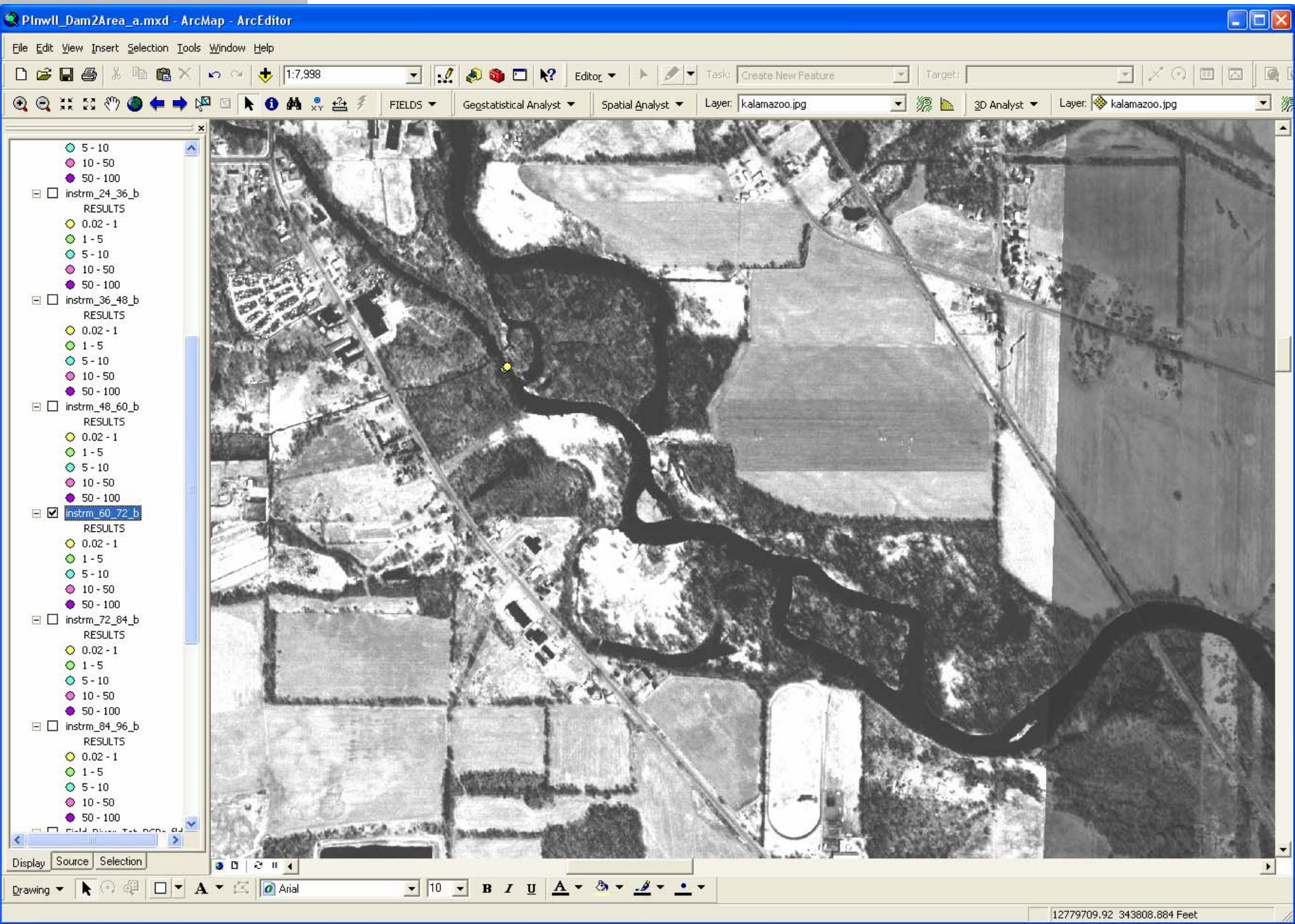
36-48” DWA interval



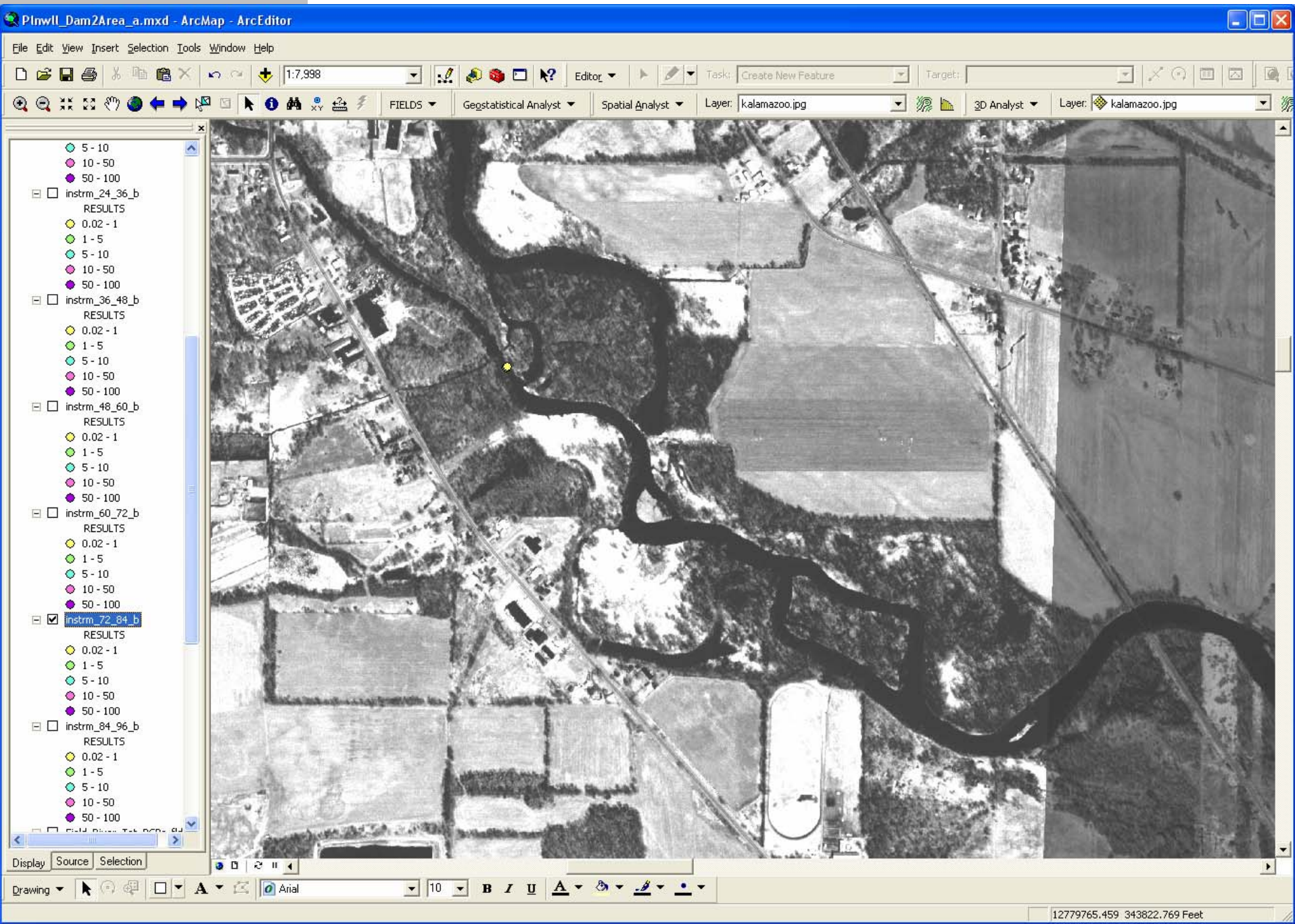
48-60” DWA interval



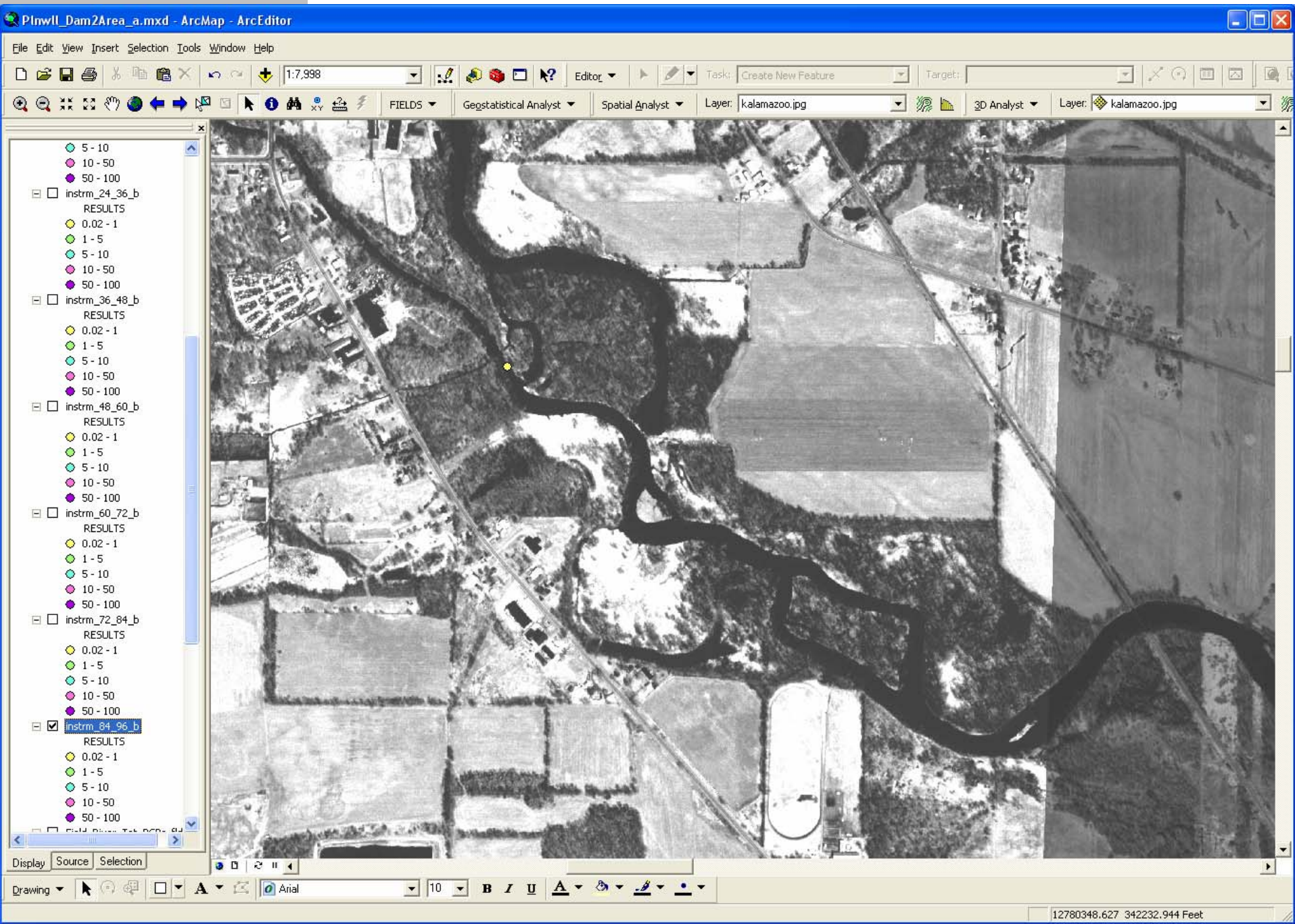
60-72” DWA interval



72-84” DWA interval



84-96” DWA interval

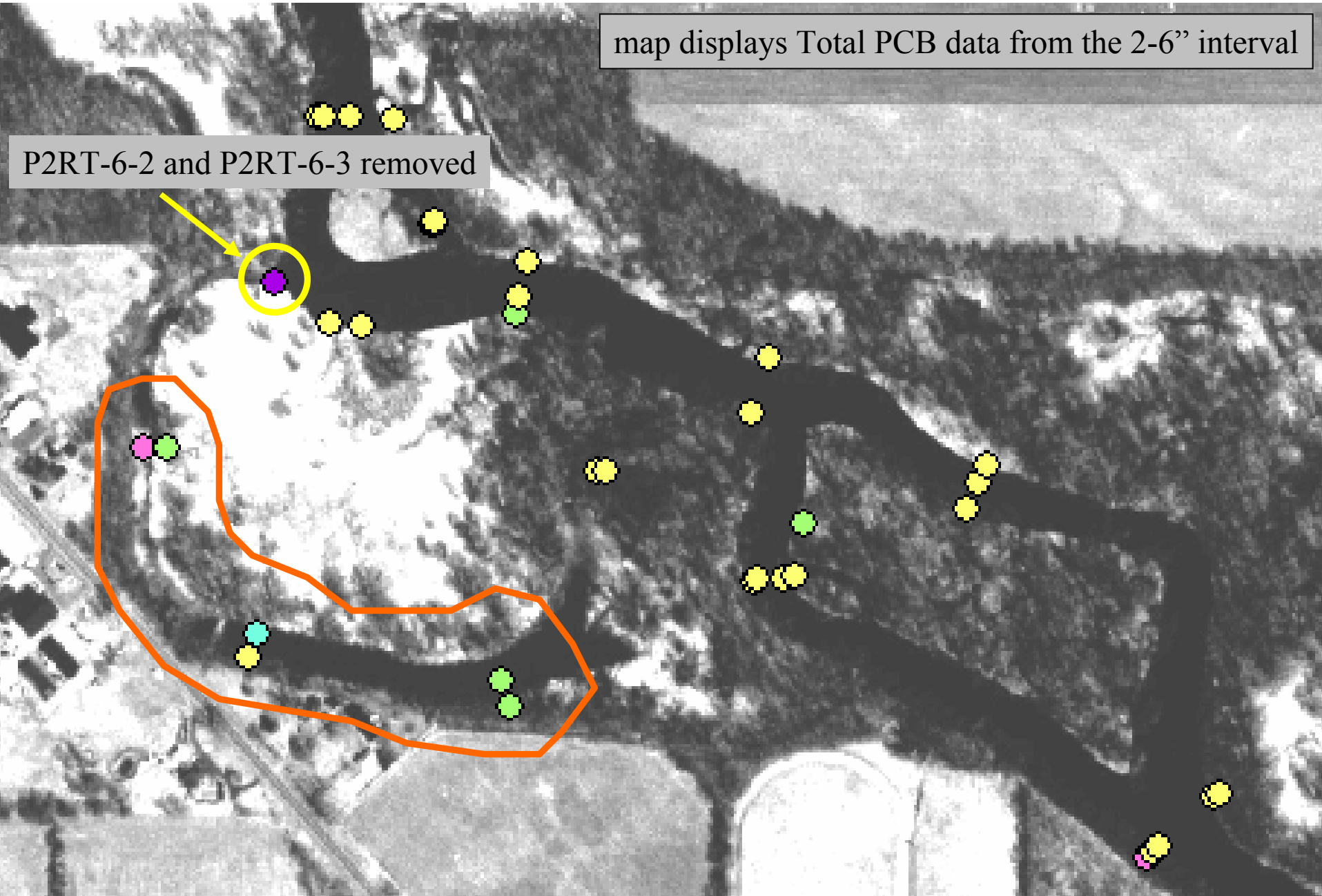


Sediment data for Total PCBs

Exploration of elevated Total PCBs in the southwest oxbow assuming that Total PCB values in sample cores P2RT-6-2 and P2RT-6-4 are removed.

- see following slides

Elevated PCBs within orange polygon



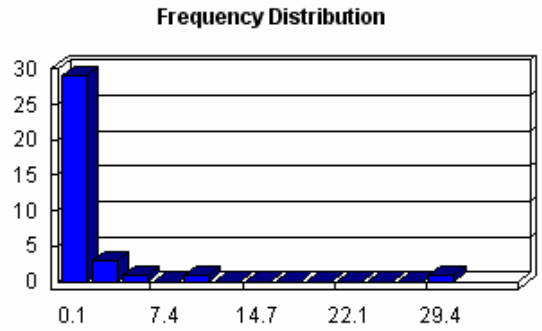
All Total PCB values in these sample cores

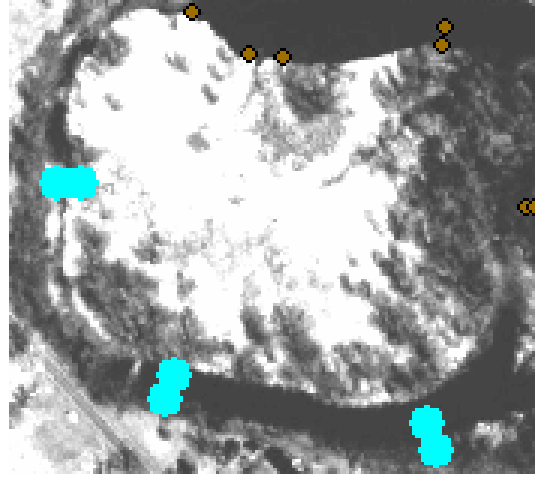
Selection Statistics of Field_River_Tot_PCBs_flds1

RESULTS

Statistics:

Count: 35
Minimum: 0.061
Maximum: 31.4
Sum: 77.105
Mean: 2.203
Standard Deviation: 5.516424



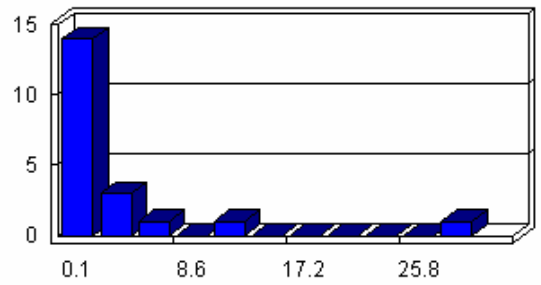


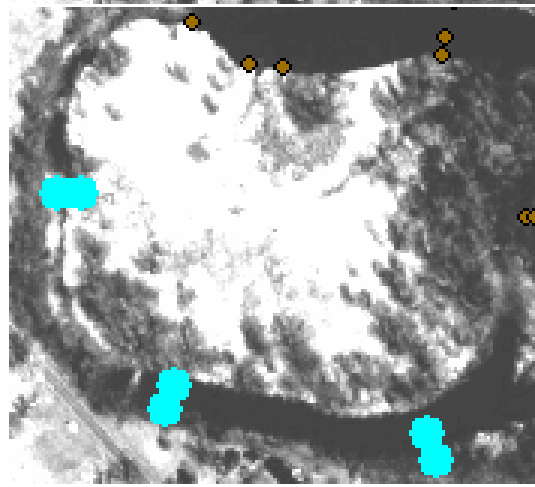
All Total PCB values in top 1 foot of these sample cores

Selection Statistics of Field_River_Tot_PCBs_flds1

Statistics:

Count: 20
Minimum: 0.063
Maximum: 31.4
Sum: 75.589
Mean: 3.77945
Standard Deviation: 6.888717



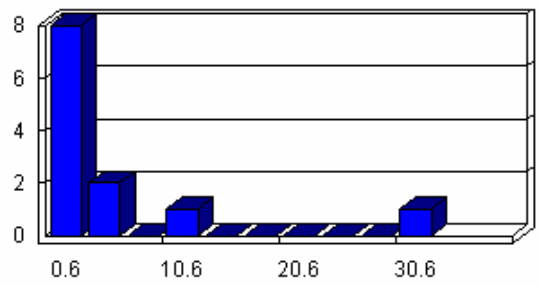


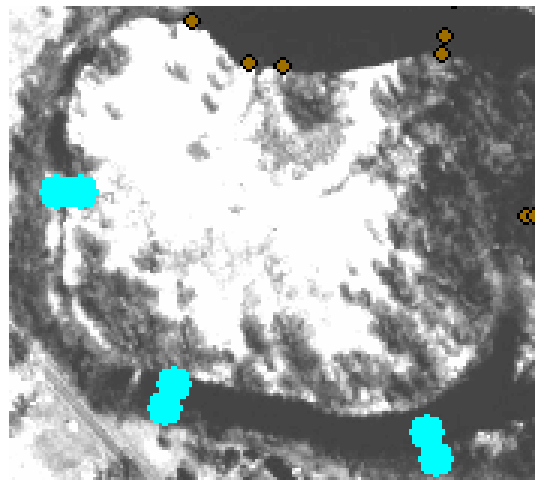
All Total PCB values in top 6 inches of these sample cores

RESULTS

Statistics:

Count: 12
Minimum: 0.587
Maximum: 31.4
Sum: 69.997
Mean: 5.833083
Standard Deviation: 8.257388





Sediment data for Total PCBs

Effect on Total PCBs concentrations in the river sediment if elevated PCBs in southwest oxbow are removed (see following slides).

- summary of changes in mean (average) and median PCB concentrations in the top 6 inches:

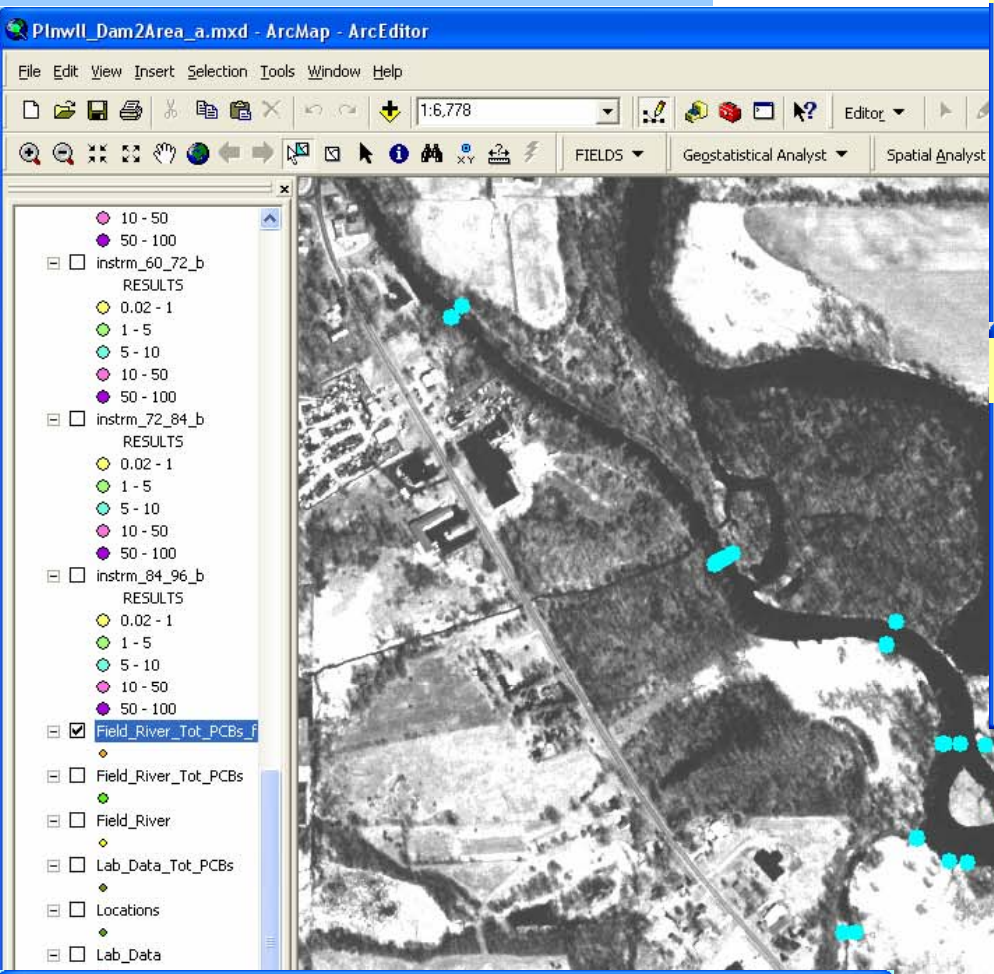
	mean (average)	median
all sample cores	3.04 ppm	0.248 ppm
excluding P2RT-6-2 and P2RT-6-4	1.73 ppm	0.231 ppm
excluding all oxbow cores	1.25 ppm	0.189 ppm
excluding all oxbow cores and P2RT-18-1	0.69 ppm	0.183 ppm

α, β, γ, δ, ε, ζ

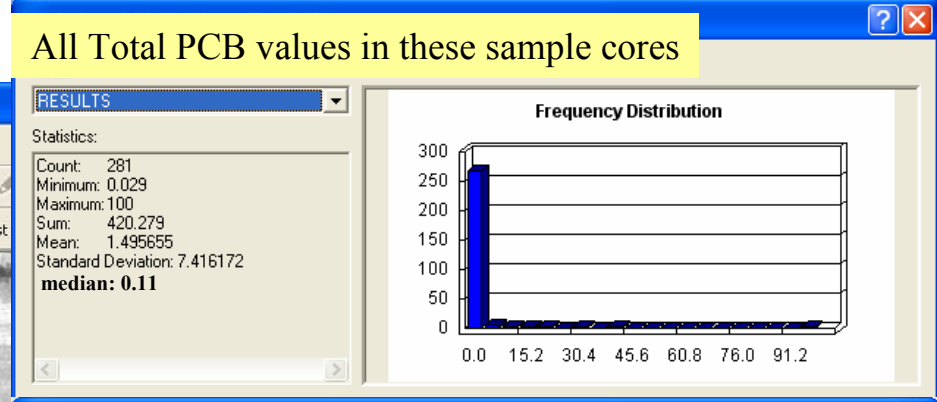
Legend:

α = 1.8 fold drop
β = 2.4 fold drop
γ = 4.4 fold drop
δ = 1.1 fold drop
ε = 1.3 fold drop
ζ = 1.4 fold drop

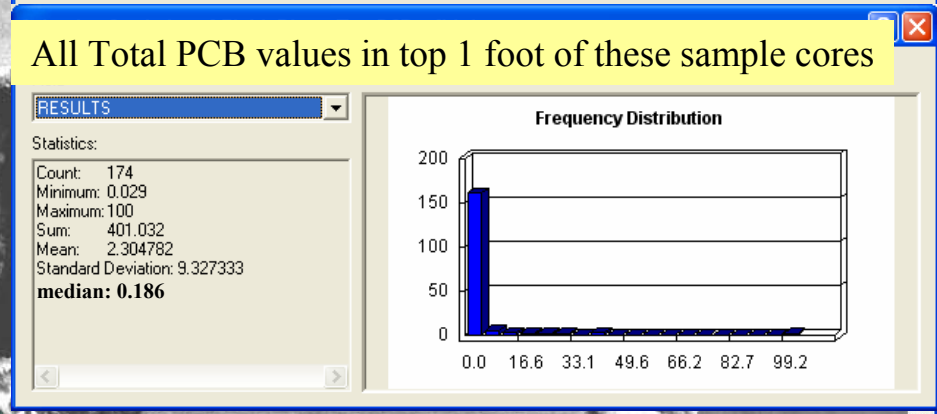
All sample locations and values



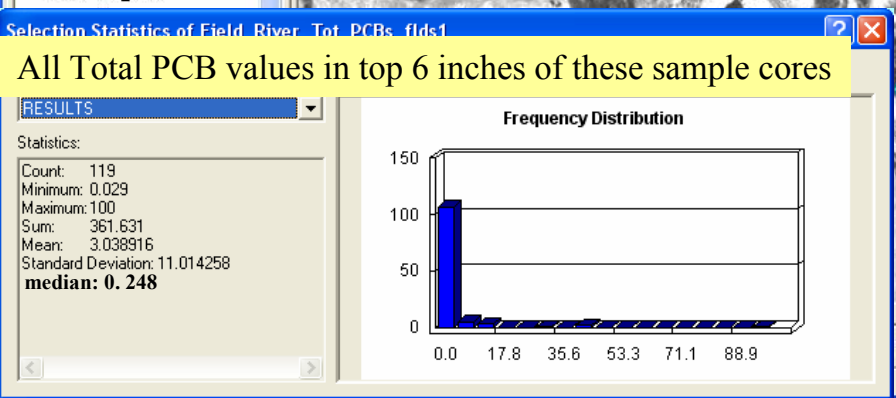
All Total PCB values in these sample cores



All Total PCB values in top 1 foot of these sample cores

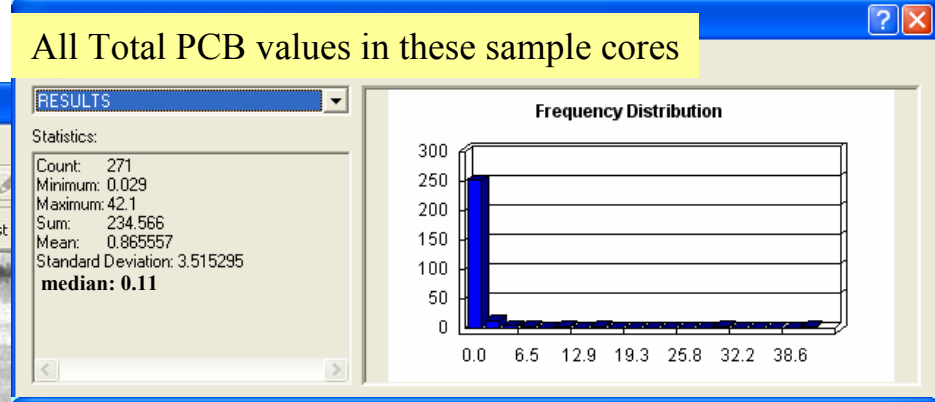


All Total PCB values in top 6 inches of these sample cores

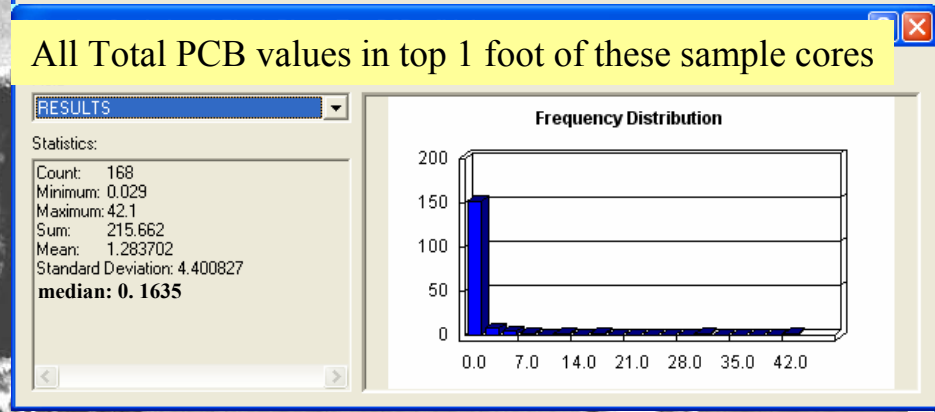


All sample locations and values, excluding orange polygon

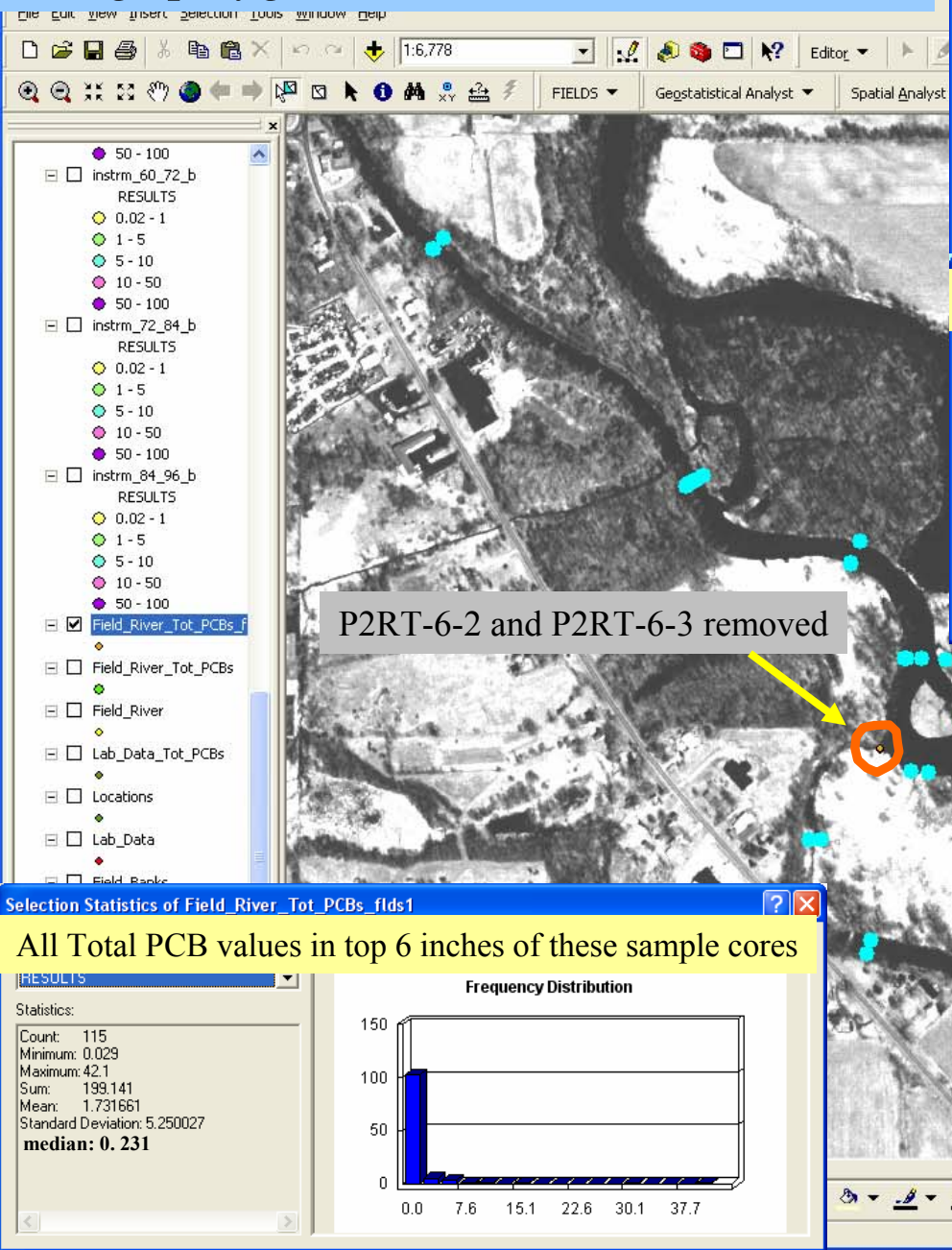
All Total PCB values in these sample cores



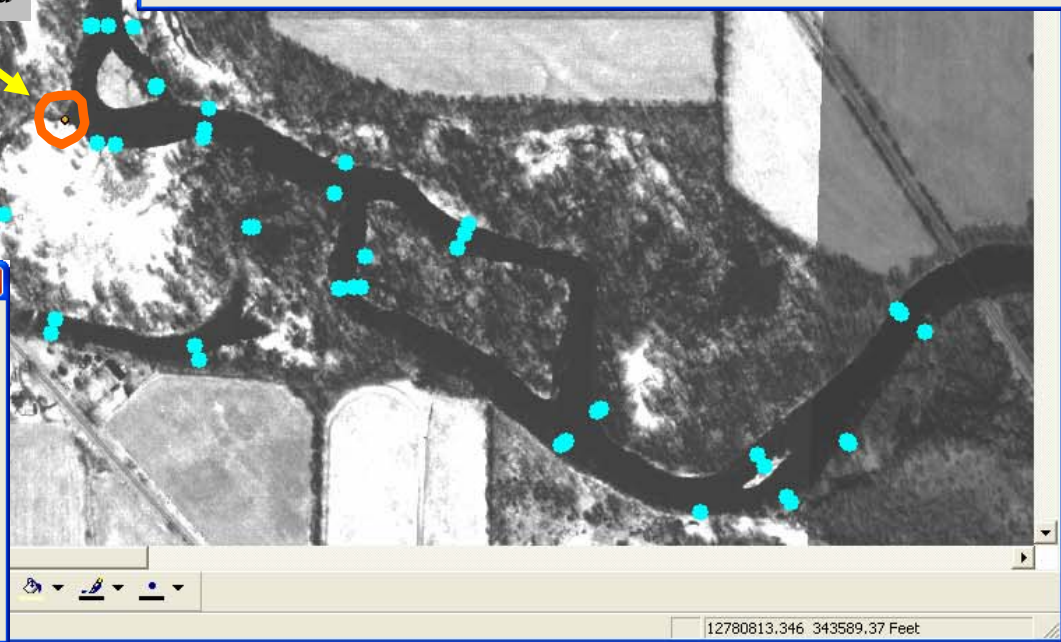
All Total PCB values in top 1 foot of these sample cores



P2RT-6-2 and P2RT-6-3 removed

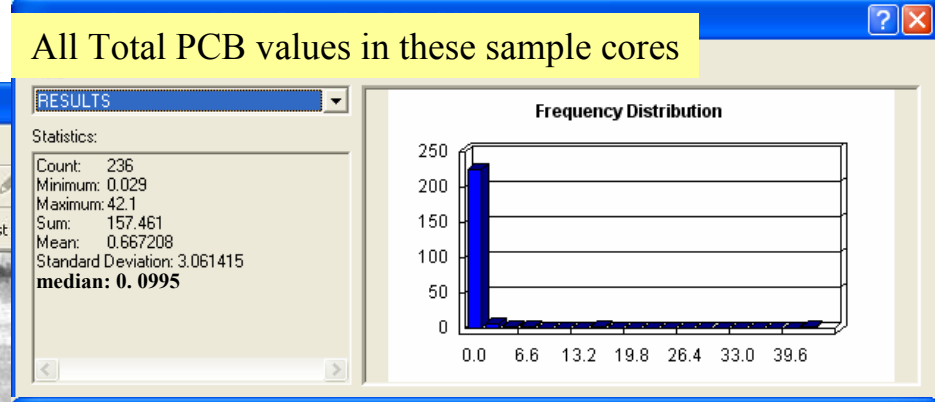


All Total PCB values in top 6 inches of these sample cores

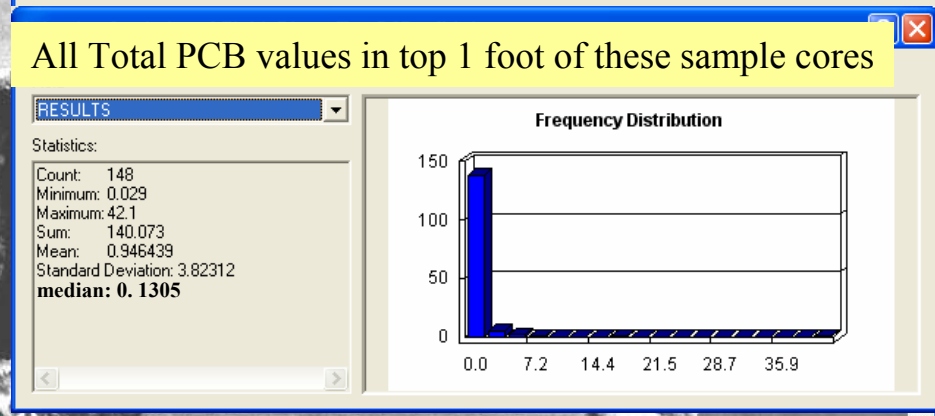


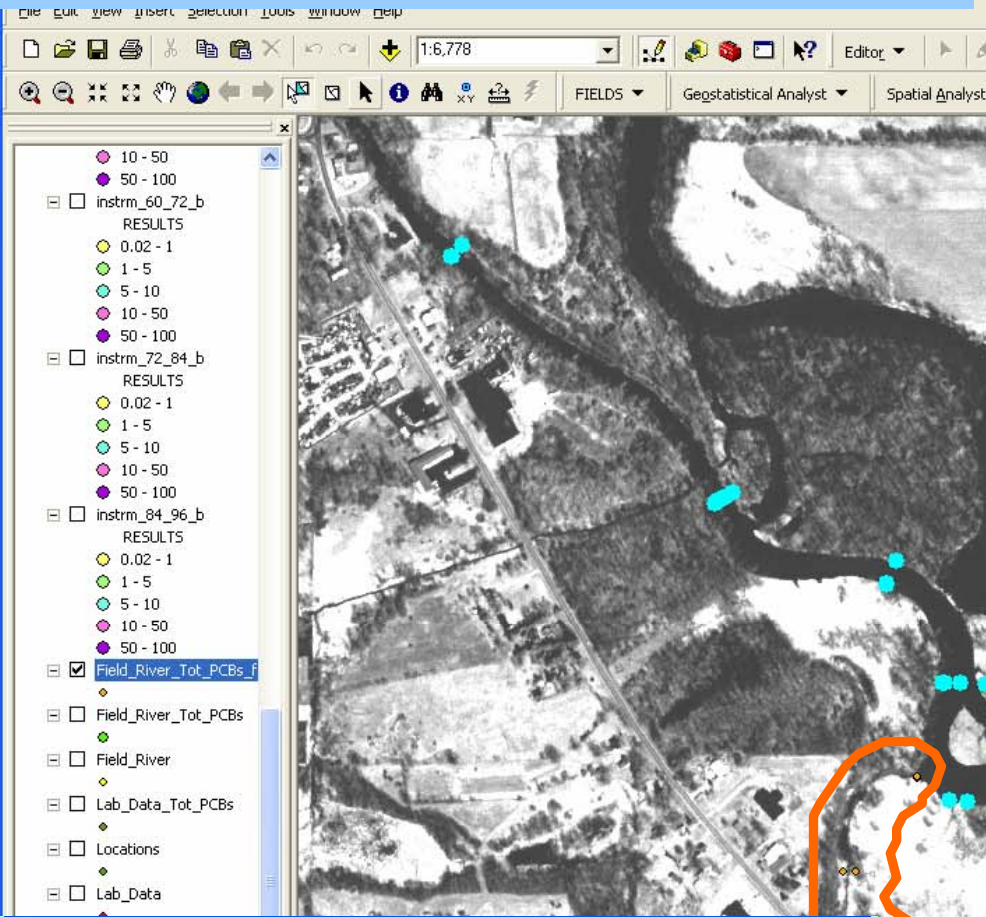
All sample locations and values, excluding orange polygon

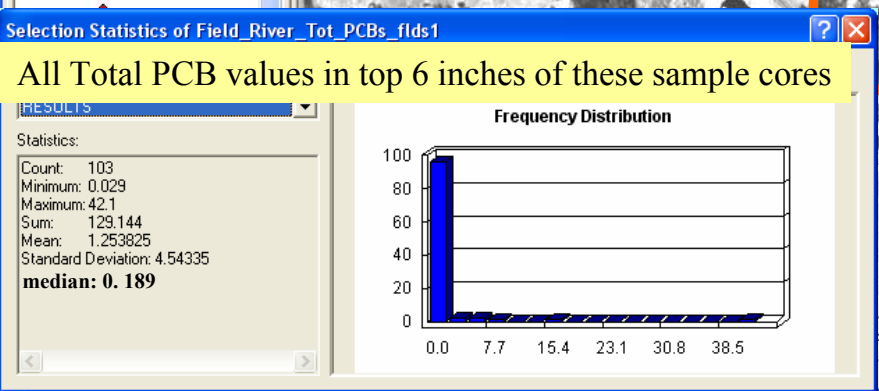
All Total PCB values in these sample cores



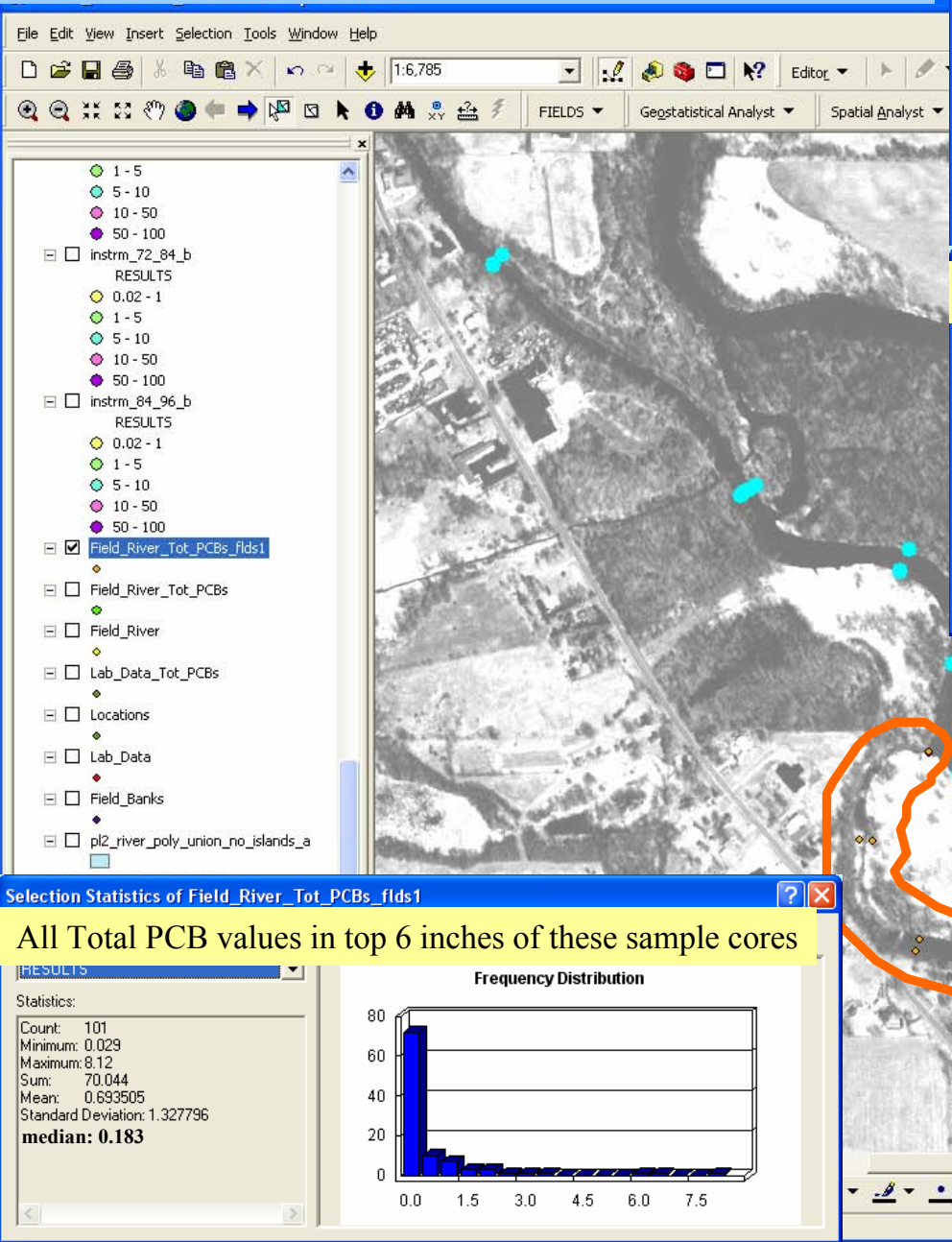
All Total PCB values in top 1 foot of these sample cores



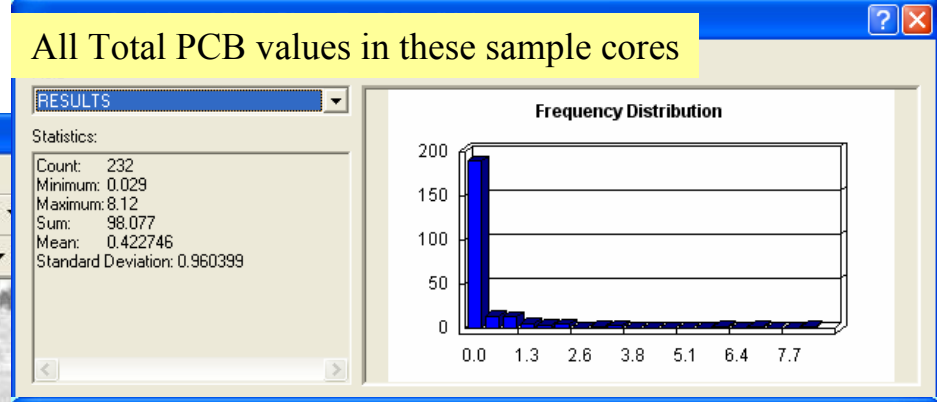




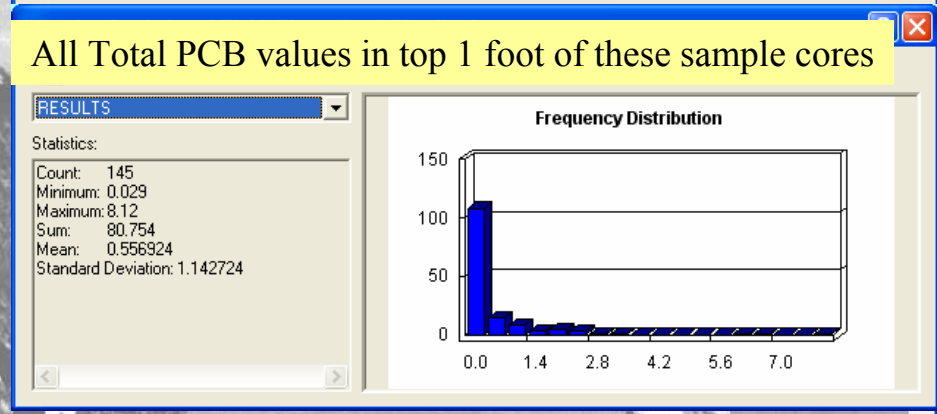
All sample locations and values, excluding orange polygons

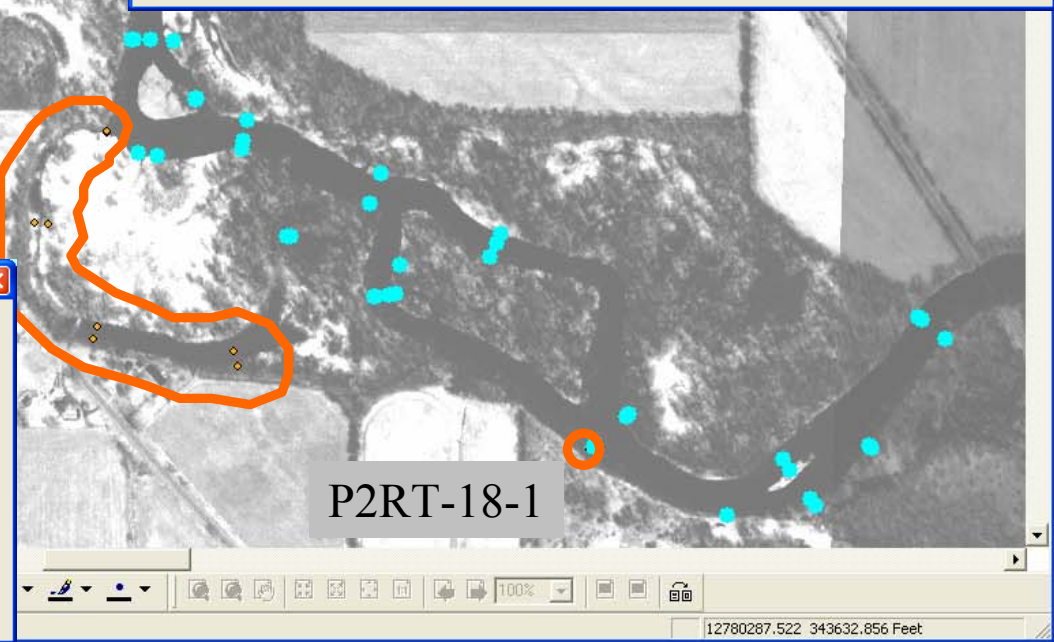


All Total PCB values in these sample cores



All Total PCB values in top 1 foot of these sample cores

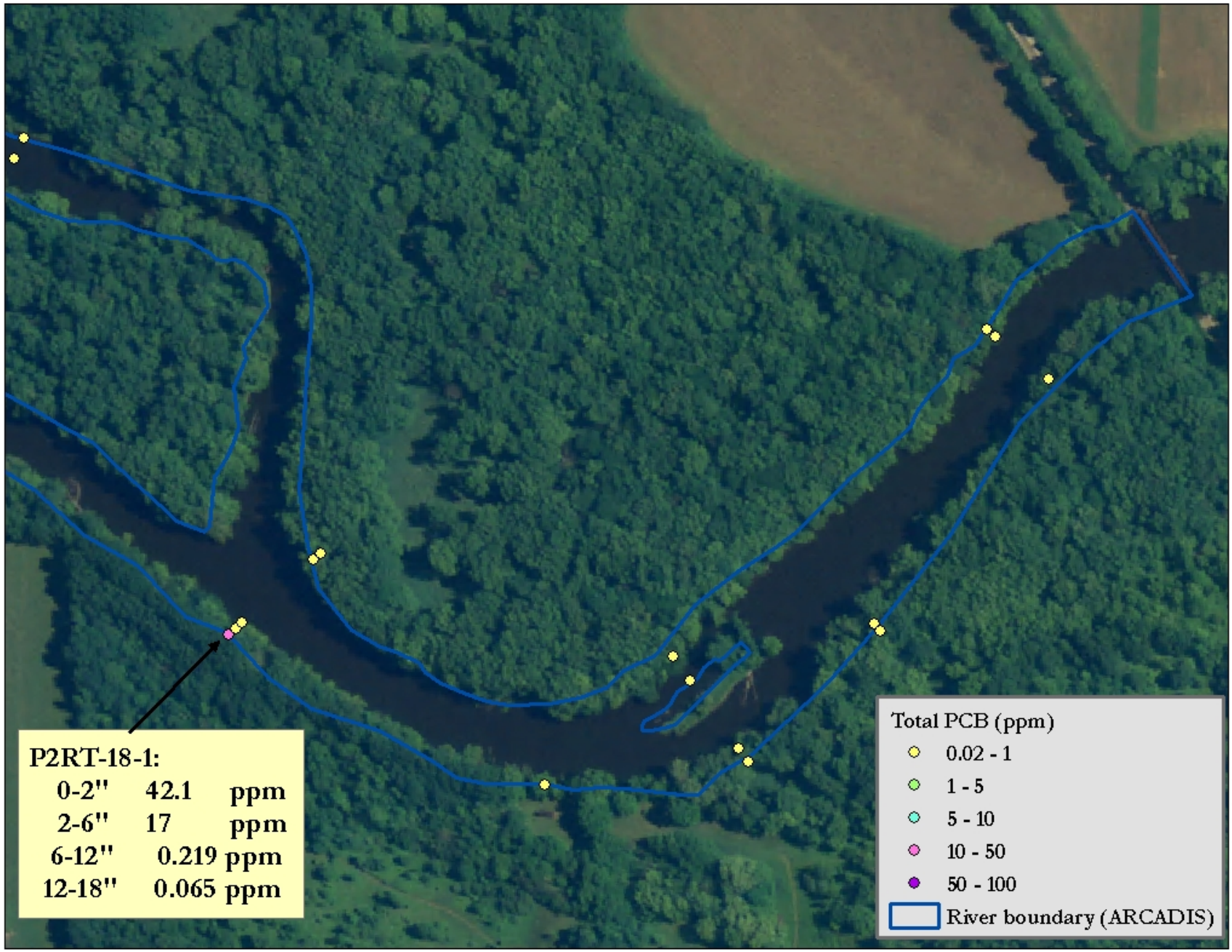




Selection Statistics of Field_River_Tot_PCBs_flds1

All Total PCB values in top 6 inches of these sample cores

Total PCB values in P2RT-18-1 core

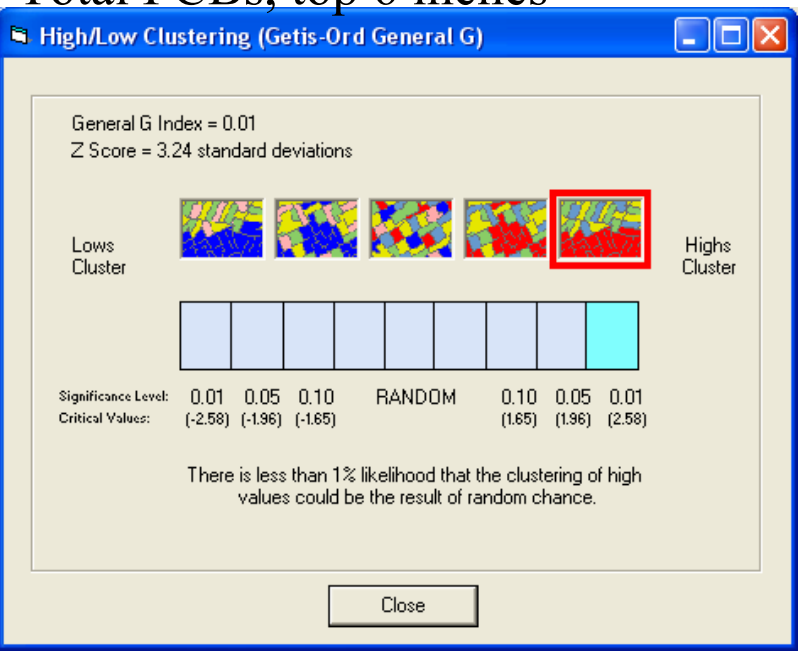


Sediment data for Total PCBs

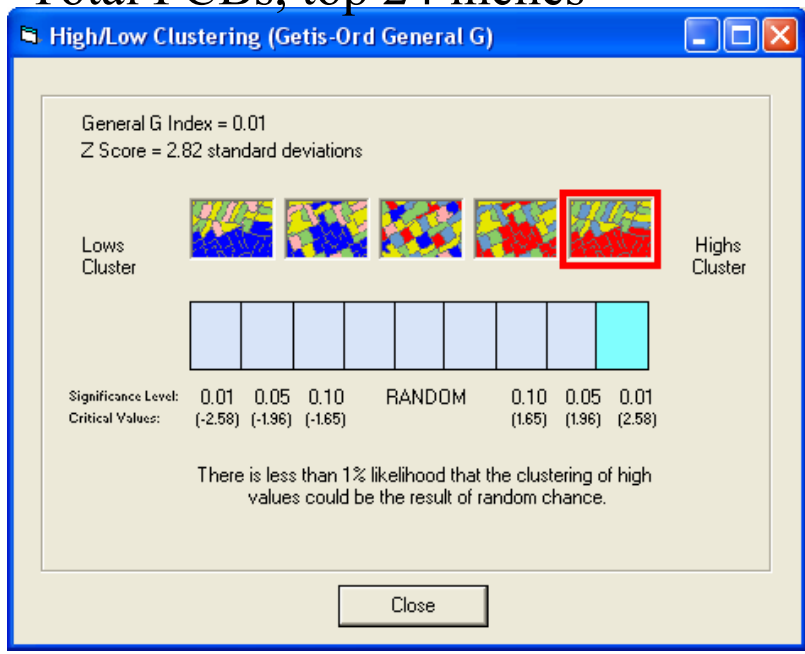
Cluster Analysis (Getis-Ord) of Total PCBs by thickness (see following slides)

- summary of results:
  high values are clustered (grouped) near other high values, i.e., the oxbow

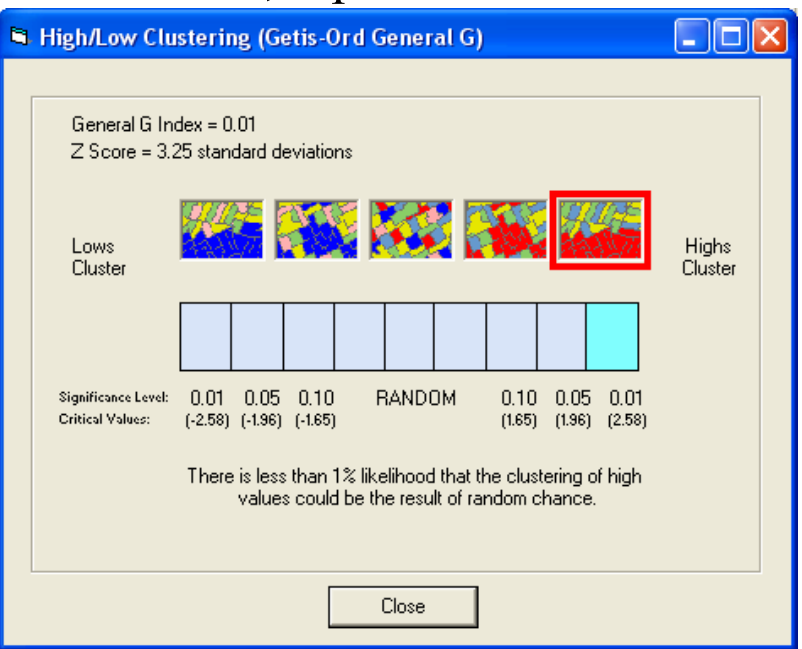
Total PCBs, top 6 inches



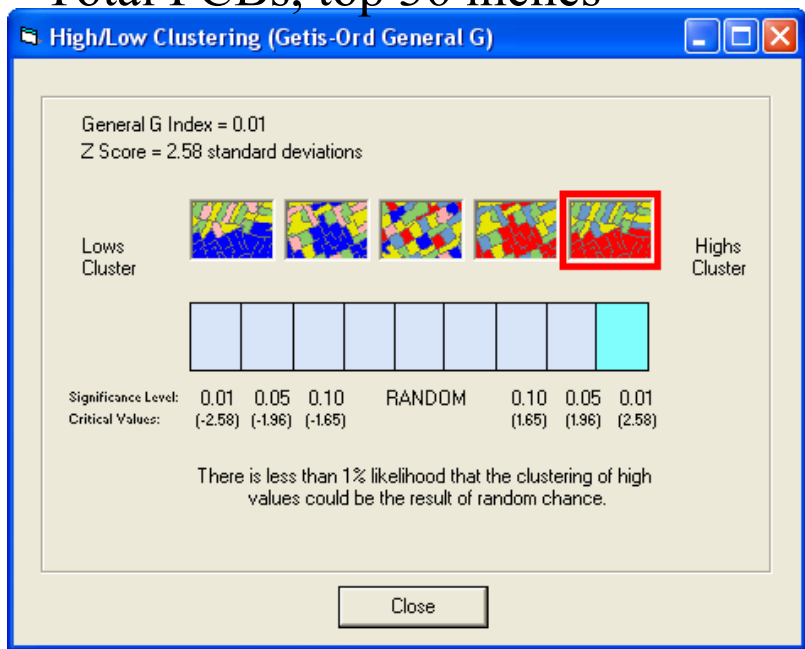
Total PCBs, top 24 inches



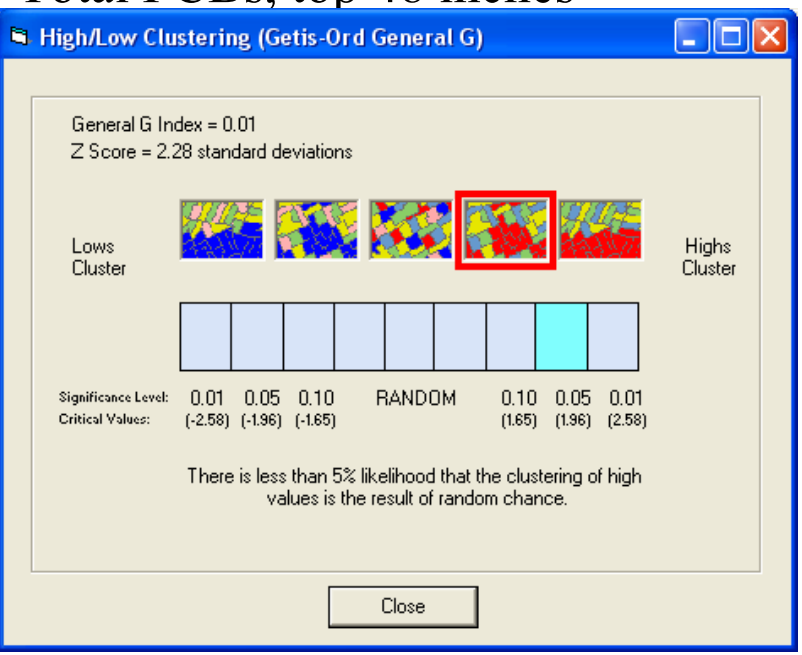
Total PCBs, top 12 inches



Total PCBs, top 36 inches



Total PCBs, top 48 inches

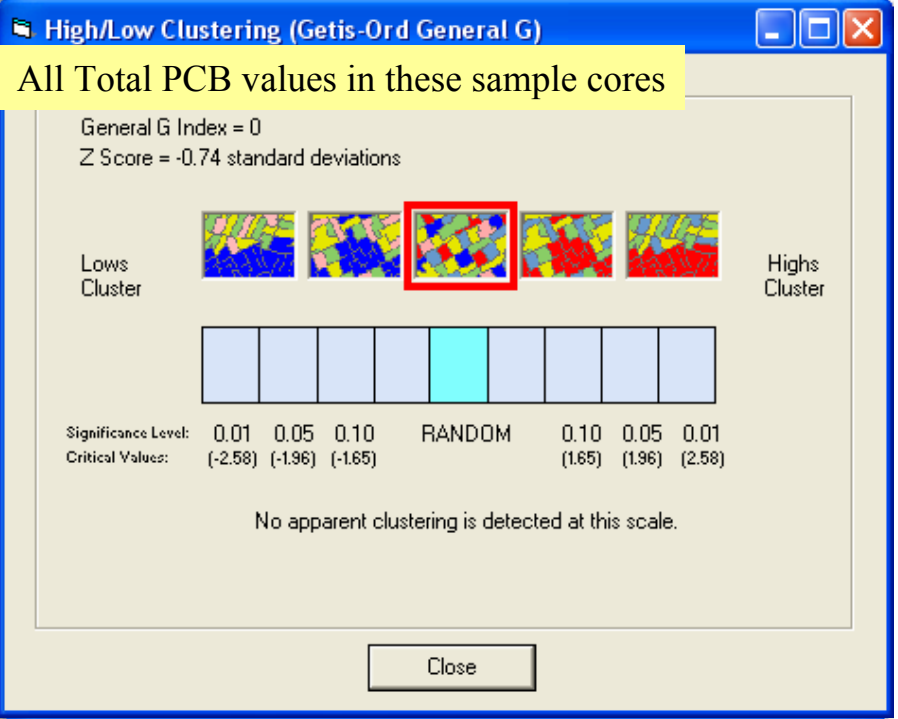


Sediment data for Total PCBs

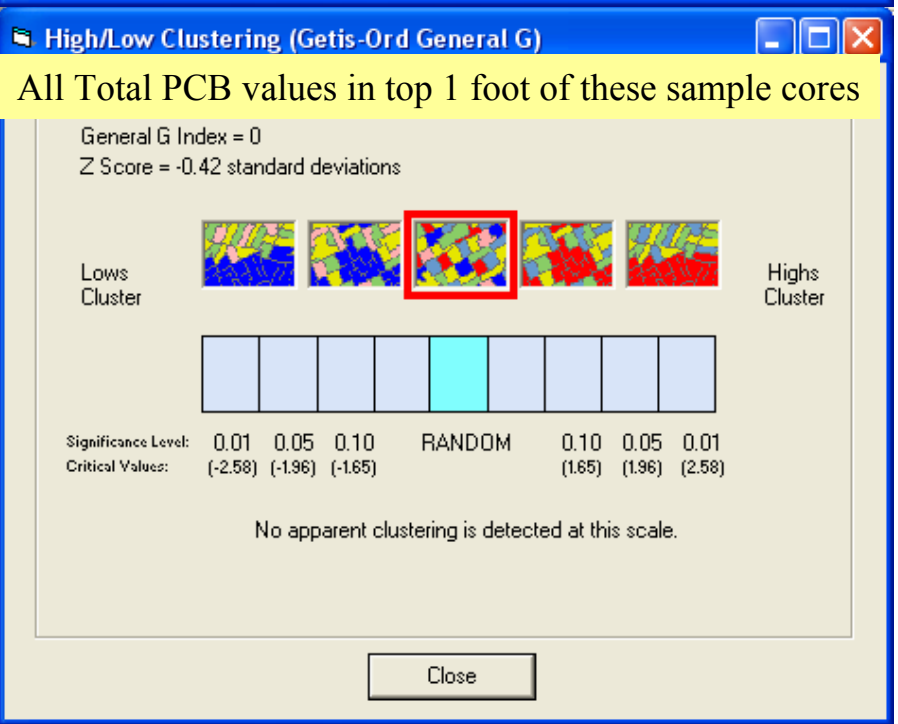
Cluster Analysis (Getis-Ord) of Total PCBs by thickness Total PCB values if sample cores P2RT-6-2 and P2RT-6-4 are removed (see following slides)

- summary of results:
  no longer are high values clustered (grouped) near other high values, i.e., the oxbow cluster is gone

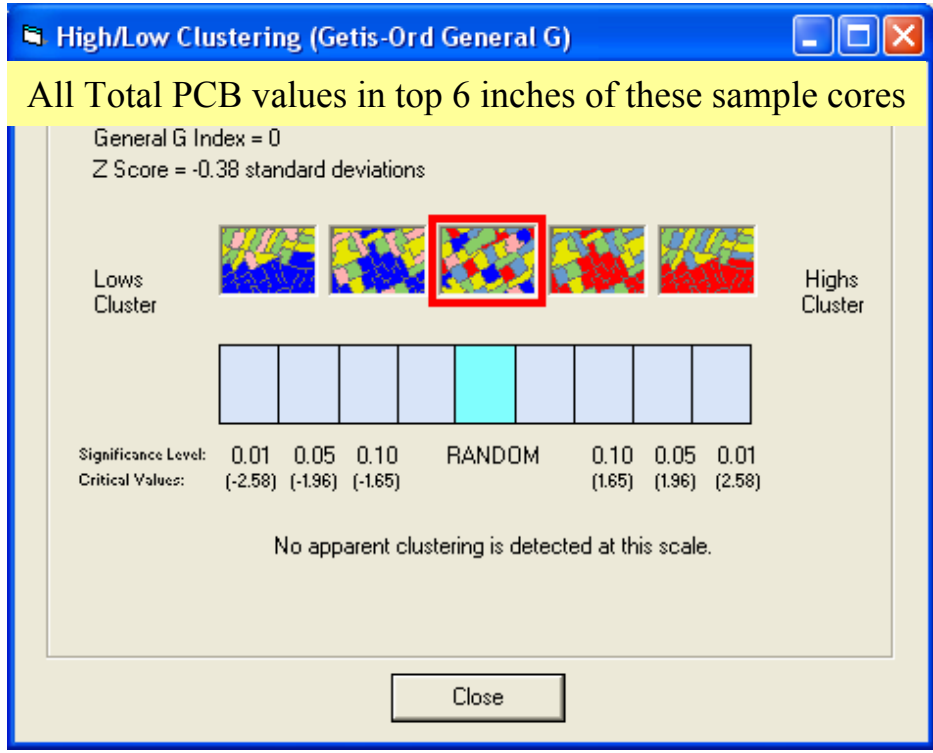
All Total PCB values in these sample cores



All Total PCB values in top 1 foot of these sample cores



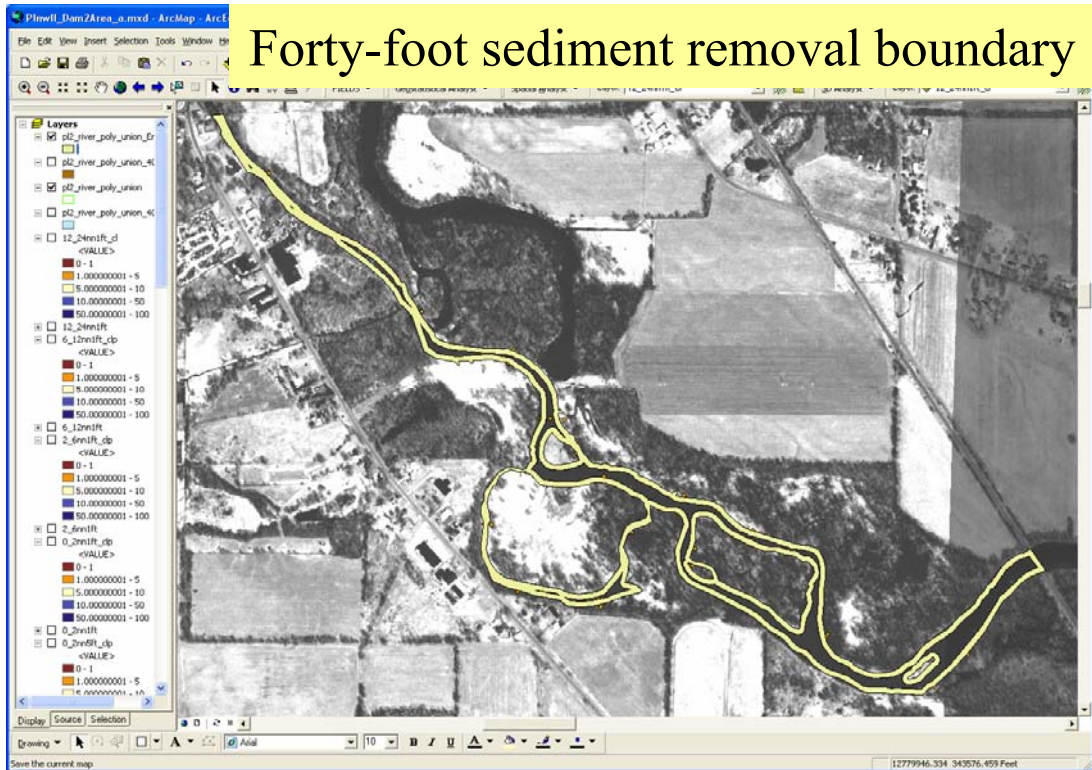
All Total PCB values in top 6 inches of these sample cores



Sediment data for Total PCBs

Estimates of mass and volume of Total PCBs in the 40-foot sediment removal boundary along shoreline. (Total PCBs are from Natural Neighbor estimates of Depth-Weighted Average (DWA) Total PCBs by interval.)

- see following slides
- used "Remediation and Mass/Volume" tool in FIELDS Tools for ArcGIS



0-2” DWA interval & 2-6” DWA interval & 6-12” DWA interval & 12-24” DWA interval

Mass Volume Report

Summary

MASS-VOLUME REPORT

Raster Layers:

Grid: 0_2nn2ft_40 : Source = D:\gis\projects\fields\Kalamazoo\samplepts\ARCADIS\SRI_Area_1_Phase_2\Plainwell_No_2_Dam_Area\john_shapefiles\0_2nn2ft_40
Grid: 2_6nn2ft_40 : Source = D:\gis\projects\fields\Kalamazoo\samplepts\ARCADIS\SRI_Area_1_Phase_2\Plainwell_No_2_Dam_Area\john_shapefiles\2_6nn2ft_40
Grid: 6_12nn2ft_40 : Source =

Name	Top Depth (inches)	Bottom Depth (inches)	Min. Conc.	Max. Conc.	Density (lb/yd3)	Vol (cu yd)	Mass (lb)	Vol (cu m)	Mass (kg)
0_2nn2ft_40	0	2	0	0.999	2500	3,287.55555	3.10100	2,513.51657	1.40659
0_2nn2ft_40	0	2	1	4.999	2500	2,165.30864	10.42488	1,655.49724	4.72865
0_2nn2ft_40	0	2	5	9.999	2500	333.90123	6.02385	255.28581	2.73237
0_2nn2ft_40	0	2	10	49.999	2500	671.30864	29.78798	513.25228	13.51160
0_2nn2ft_40	0	2	50	100	2500	0.00000	0.00000	0.00000	0.00000
Subtotals:						6,458.07407	49.33771	4,937.55190	22.37921

2_6nn2ft_40	2	6	0	0.999	2500	6,888.24691	5.41962	5,266.44264	2.45830
2_6nn2ft_40	2	6	1	4.999	2500	4,660.14814	27.89377	3,562.93890	12.65240
2_6nn2ft_40	2	6	5	9.999	2500	759.95062	13.21497	581.02394	5.99421
2_6nn2ft_40	2	6	10	49.999	2500	604.98765	29.61992	462.54625	13.43537
2_6nn2ft_40	2	6	50	100	2500	2.56790	0.41234	1.96330	0.18704
Subtotals:						12,915.90122	76.56062	9,874.91502	34.72731

6_12nn2ft_40	6	12	0	0.999	2500	18,018.88887	12.11509	13,776.42902	5.49531
6_12nn2ft_40	6	12	1	4.999	2500	1,306.88889	4.75238	999.18825	2.15564
6_12nn2ft_40	6	12	5	9.999	2500	34.74074	0.60317	26.56120	0.27359
6_12nn2ft_40	6	12	10	49.999	2500	5.48148	0.17912	4.19089	0.08125
6_12nn2ft_40	6	12	50	100	2500	0.00000	0.00000	0.00000	0.00000
Subtotals:						19,365.99998	17.64976	14,806.36937	8.00580

12_24nn2ft_40	12	24	0	0.999	2500	36,188.59256	14.75788	27,668.16424	6.69406
12_24nn2ft_40	12	24	1	4.999	2500	2,567.40740	10.13396	1,962.92380	4.59669
12_24nn2ft_40	12	24	5	9.999	2500	0.00000	0.00000	0.00000	0.00000
12_24nn2ft_40	12	24	10	49.999	2500	0.00000	0.00000	0.00000	0.00000
12_24nn2ft_40	12	24	50	100	2500	0.00000	0.00000	0.00000	0.00000
Subtotals:						38,755.99996	24.89184	29,631.08805	11.29075

GRAND TOTALS:						77,495.97523	168.43993	59,249.92434	76.40307

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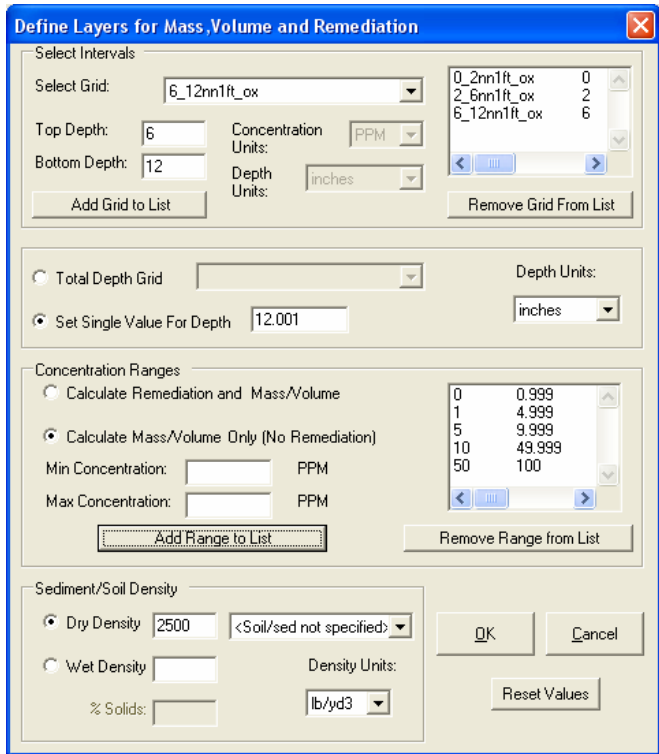
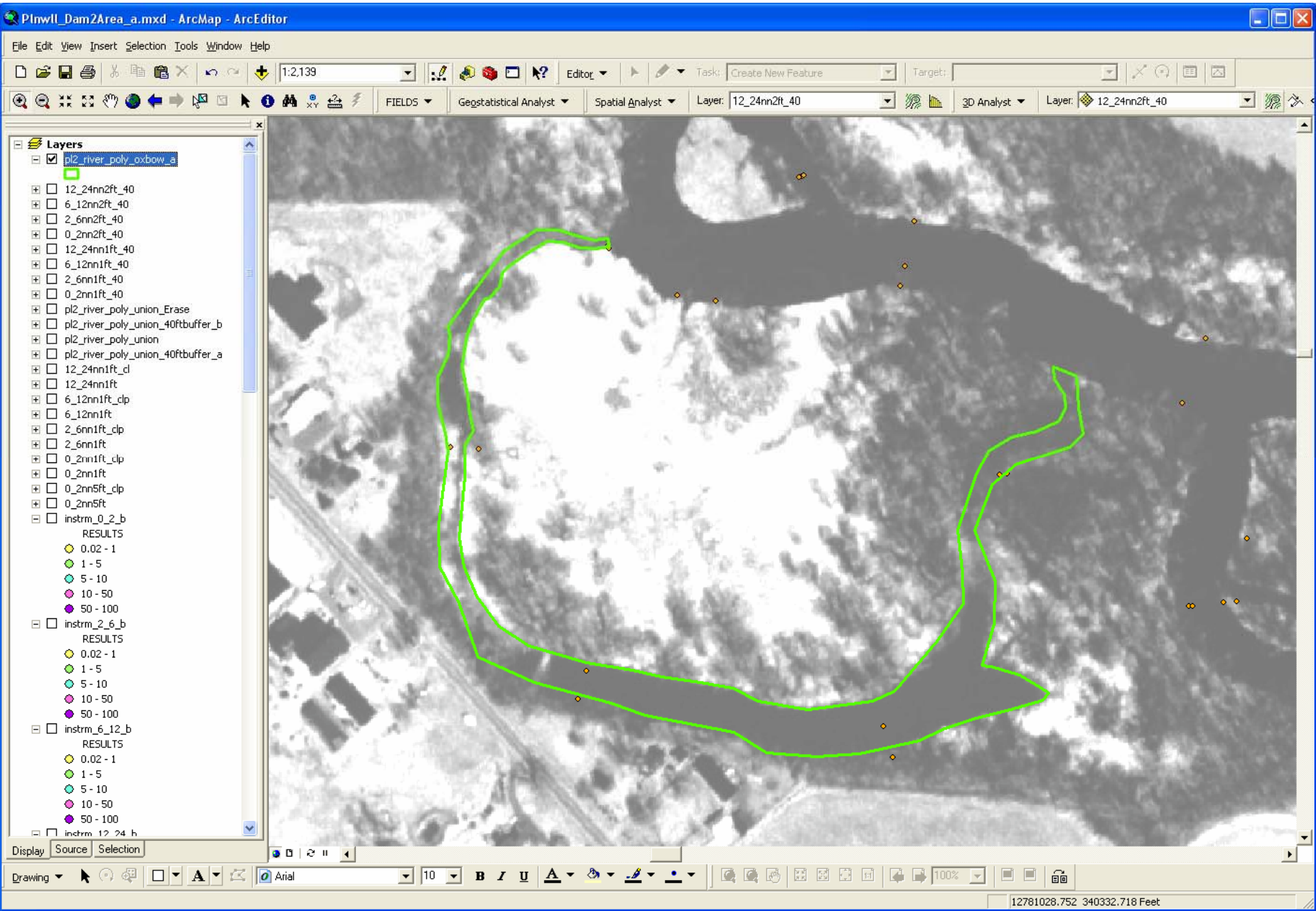
Sediment data for Total PCBs

Estimate of mass and volume of Total PCBs in the oxbow sediment. (Total PCBs are from Natural Neighbor estimates of Depth-Weighted Average (DWA) Total PCBs by interval.)

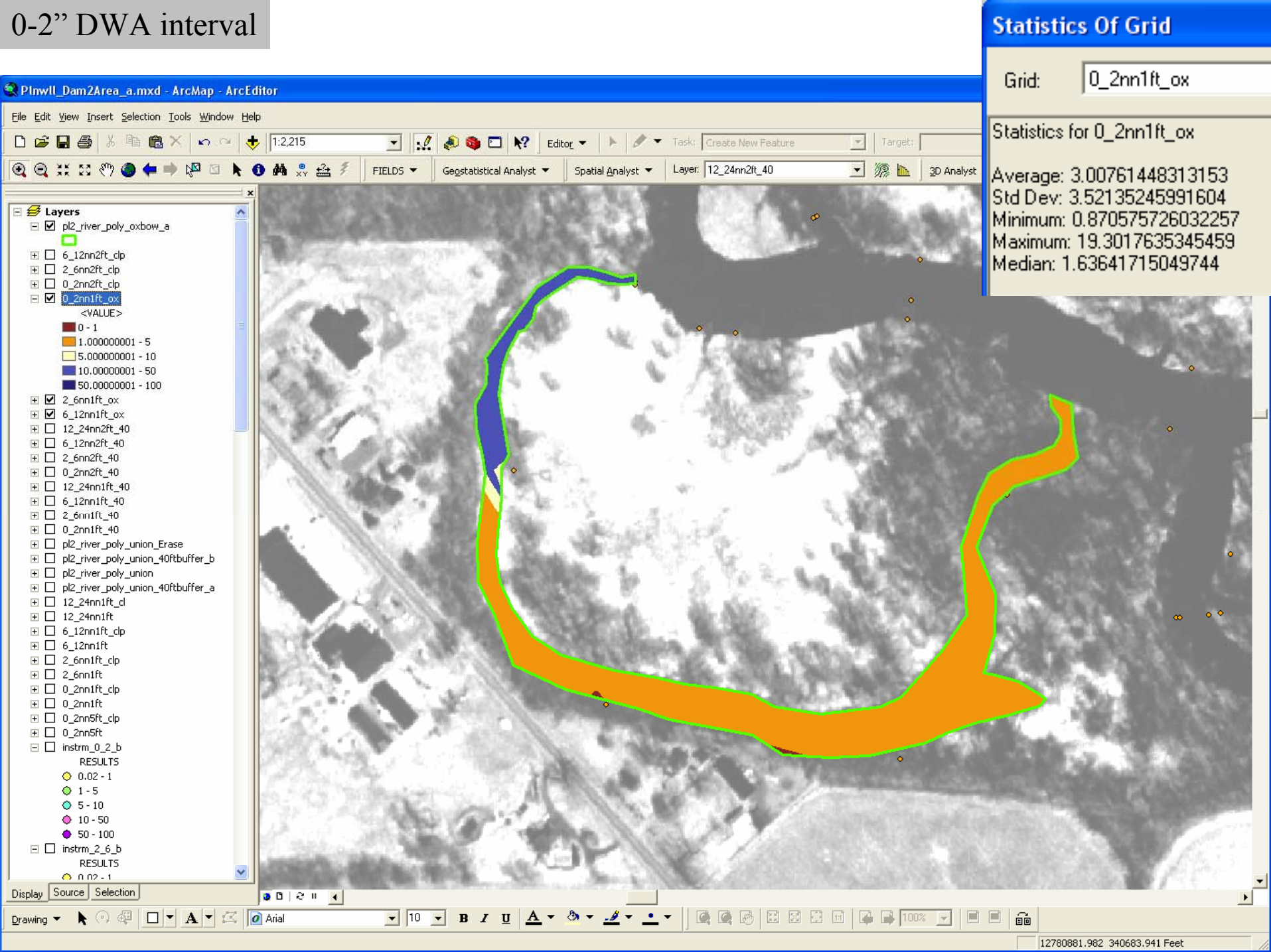
- see following slides
- used “Remediation and Mass/Volume” tool in FIELDS Tools for ArcGIS



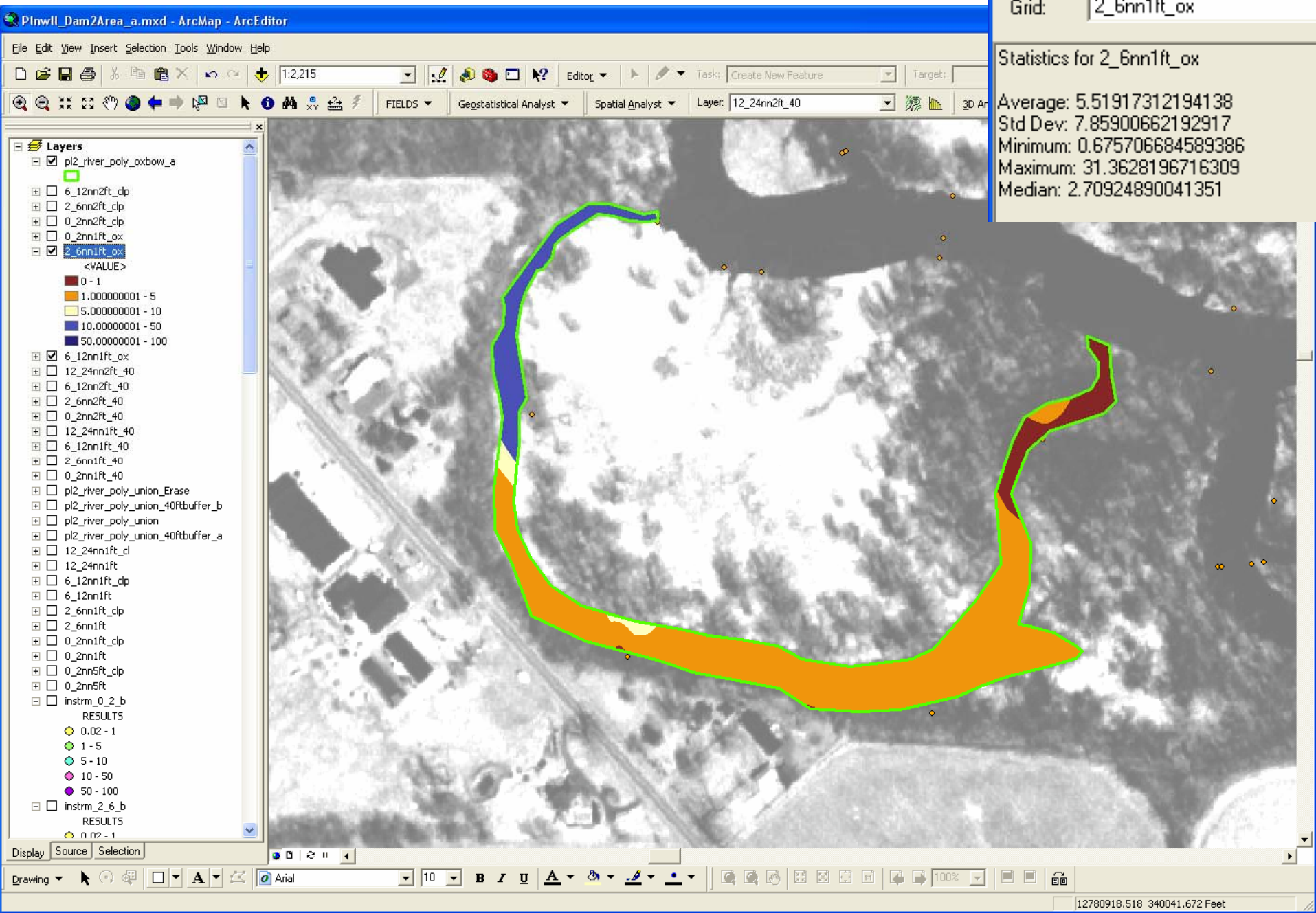
Oxbow polygon used for instream data



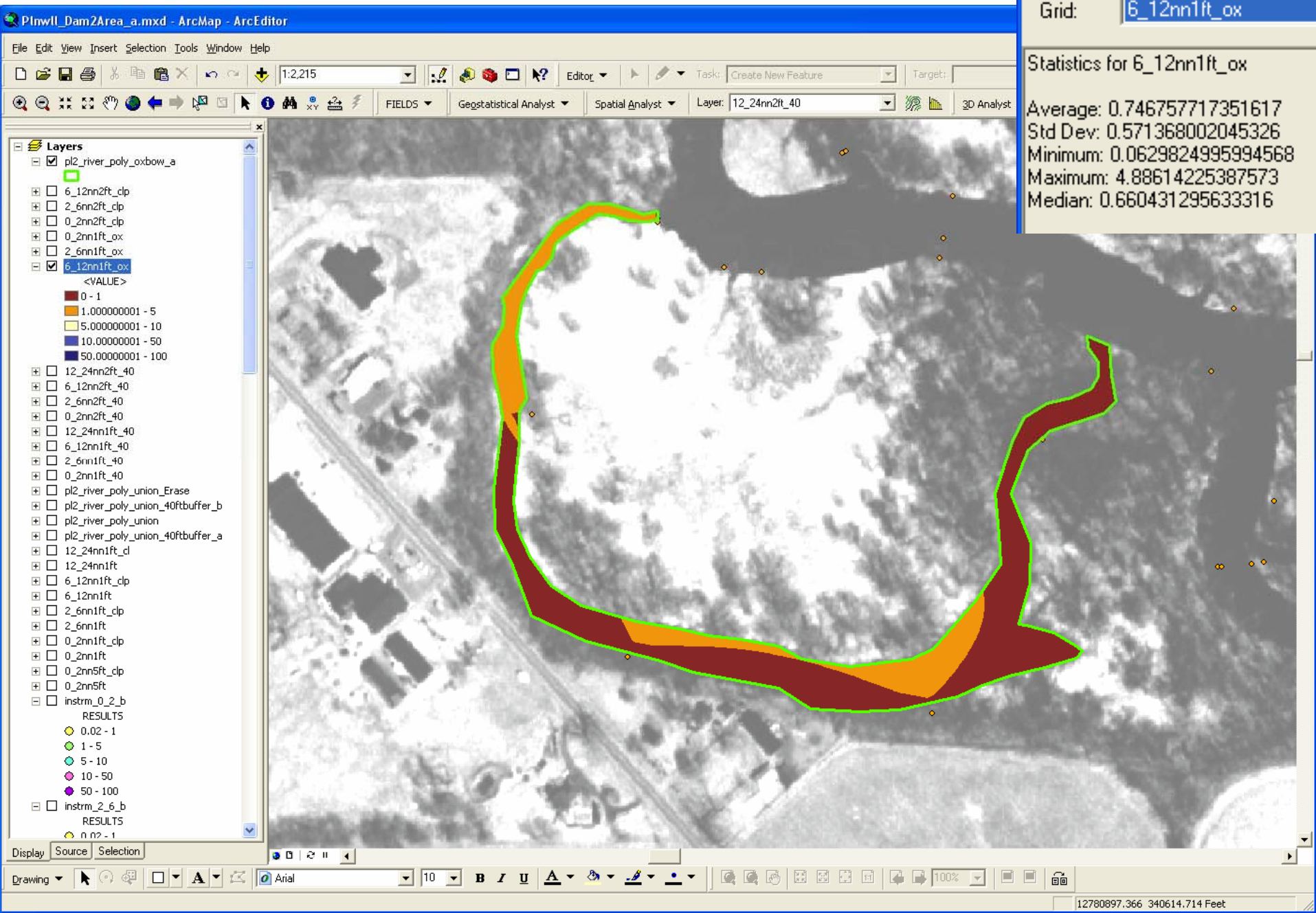
0-2” DWA interval



2-6” DWA interval



6-12” DWA interval



0-2” DWA interval

2-6” DWA interval

6-12” DWA interval

Mass Volume Report

Summary

MASS-VOLUME REPORT

Raster Layers:

Grid: 0_2nn1ft_ox : Source = D:\gis\projects\fields\Kalamazoo\samplepts\ARCADIS\SRI_Area_1_Phase_2\Plainwell_No_2_Dam_Area\john_shapefiles\0_2nn1ft_ox
Grid: 2_6nn1ft_ox : Source = D:\gis\projects\fields\Kalamazoo\samplepts\ARCADIS\SRI_Area_1_Phase_2\Plainwell_No_2_Dam_Area\john_shapefiles\2_6nn1ft_ox
Grid: 6_12nn1ft_ox : Source =

Name	Top Depth (inches)	Bottom Depth (inches)	Min. Conc.	Max. Conc.	Density (lb/yd3)	Vol (cu yd)	Mass (lb)	Vol (cu m)	Mass (kg)
0_2nn1ft_ox	0	2	0	0.999	2500	6.01852	0.01412	4.60149	0.00640
0_2nn1ft_ox	0	2	1	4.999	2500	923.51234	3.78182	706.07585	1.71540
0_2nn1ft_ox	0	2	5	9.999	2500	11.24074	0.22072	8.59416	0.10012
0_2nn1ft_ox	0	2	10	49.999	2500	136.07407	4.08040	104.03609	1.85084
0_2nn1ft_ox	0	2	50	100	2500	0.00000	0.00000	0.00000	0.00000
Subtotals:						1,076.84568	8.09706	823.30759	3.67276

2_6nn1ft_ox	2	6	0	0.999	2500	208.40741	0.46006	159.33890	0.20868
2_6nn1ft_ox	2	6	1	4.999	2500	1,594.35802	10.14357	1,218.97417	4.60105
2_6nn1ft_ox	2	6	5	9.999	2500	51.83951	0.80570	39.63415	0.36546
2_6nn1ft_ox	2	6	10	49.999	2500	298.20988	18.30569	227.99781	8.30332
2_6nn1ft_ox	2	6	50	100	2500	0.00000	0.00000	0.00000	0.00000
Subtotals:						2,152.81481	29.71503	1,645.94502	13.47851

6_12nn1ft_ox	6	12	0	0.999	2500	2,254.22222	2.48068	1,723.47655	1.12522
6_12nn1ft_ox	6	12	1	4.999	2500	974.09259	3.54476	744.74722	1.60787
6_12nn1ft_ox	6	12	5	9.999	2500	0.00000	0.00000	0.00000	0.00000
6_12nn1ft_ox	6	12	10	49.999	2500	0.00000	0.00000	0.00000	0.00000
6_12nn1ft_ox	6	12	50	100	2500	0.00000	0.00000	0.00000	0.00000
Subtotals:						3,228.31481	6.02544	2,468.22377	2.73309

GRAND TOTALS:						6,457.97530	43.83752	4,937.47639	19.88437

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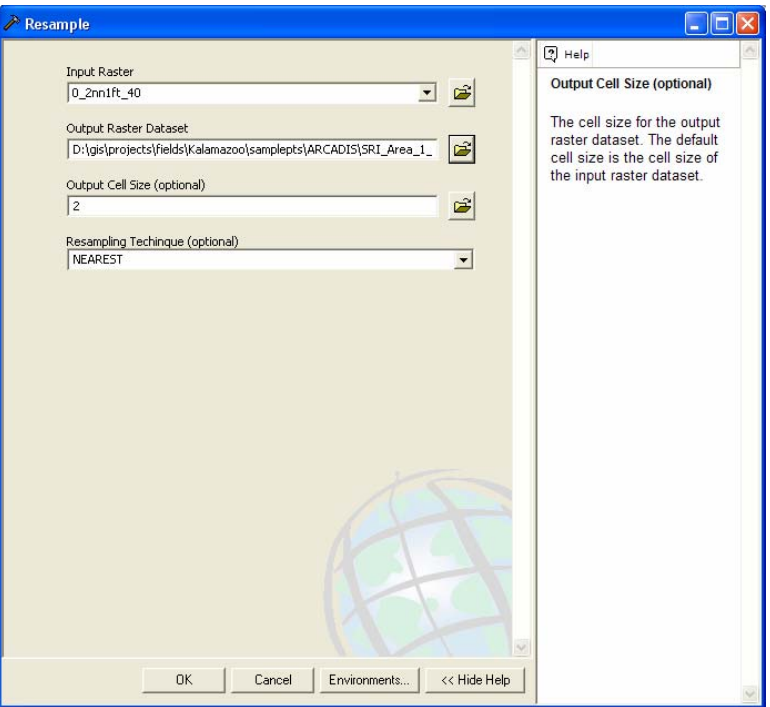
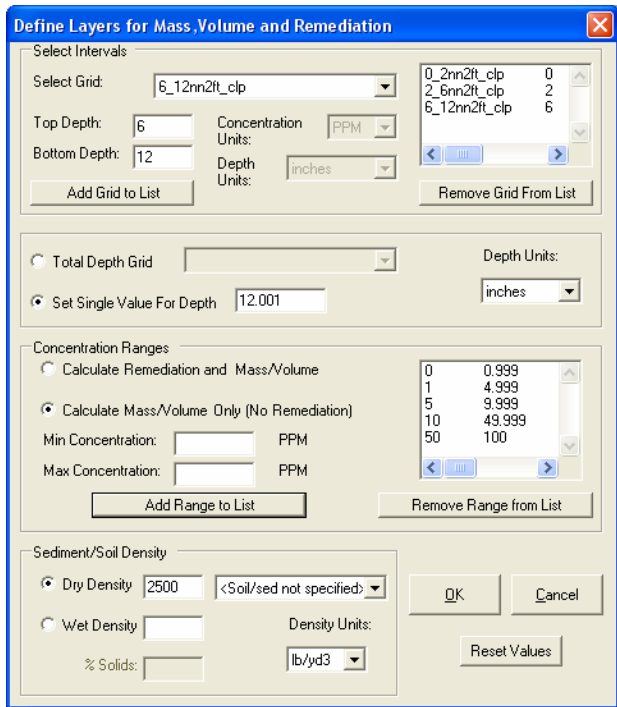
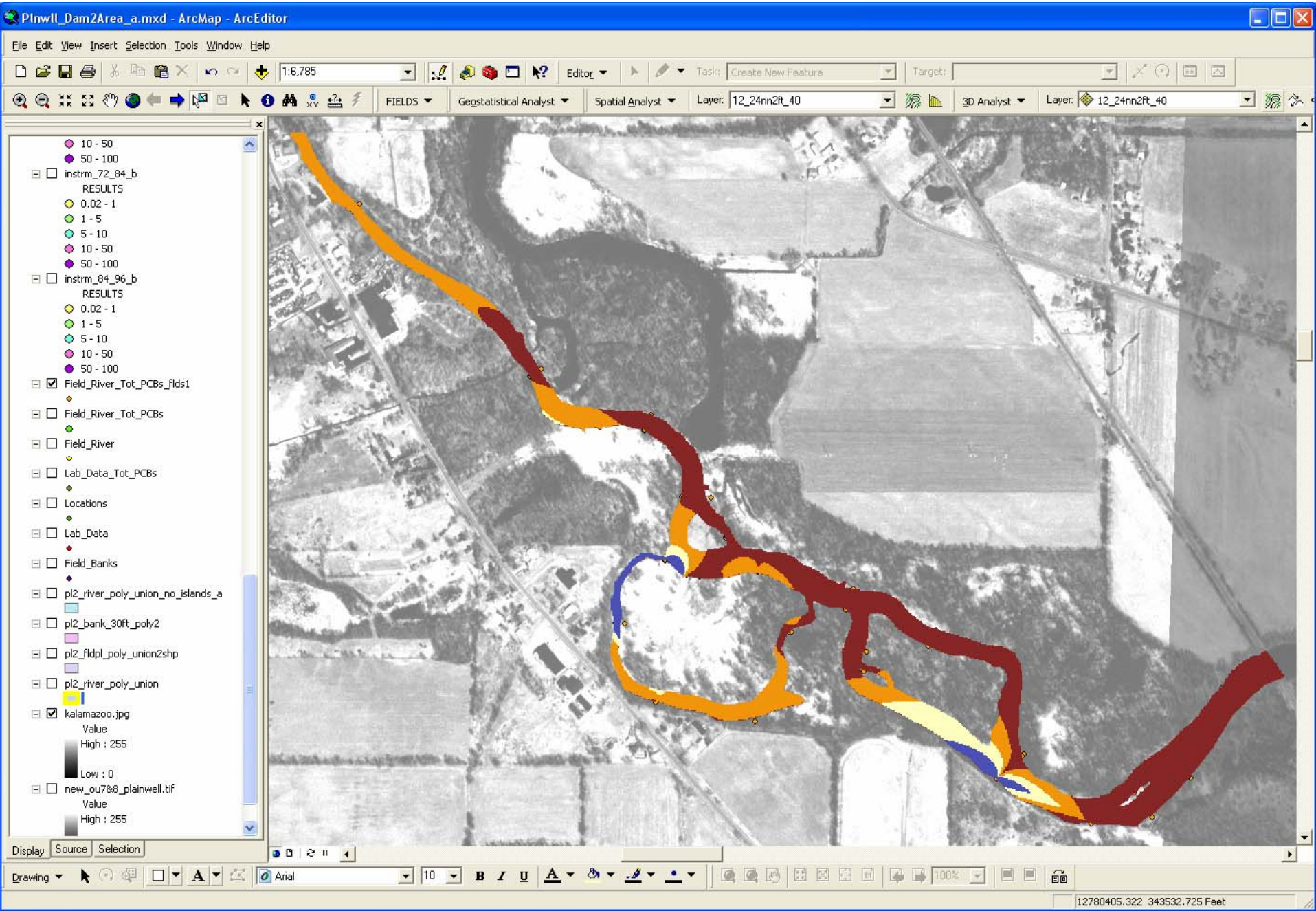
Sediment data for Total PCBs

Estimate of mass and volume of Total PCBs in the river sediment. (Total PCBs are from Natural Neighbor estimates of Depth-Weighted Average (DWA) Total PCBs by interval.)

- see following slides
- use “Remediation and Mass/Volume” tool in FIELDS Tools for ArcGIS
  - tool required less dense grid, grids resampled to 2-foot cells






Plnwll_Dam2Area_a.mxd - ArcMap - ArcEditor
File Edit View Insert Selection Tools Window Help
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Editor
Task: Create New Feature
Target:
FIELDS
Geostatistical Analyst
Spatial Analyst
Layer: 12_24nn2ft_40
3D Analyst
Layer: 12_24nn2ft_40
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50 - 100
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RESULTS
0.02 - 1
1 - 5
5 - 10
10 - 50
50 - 100
instrm_84_96_b
RESULTS
0.02 - 1
1 - 5
5 - 10
10 - 50
50 - 100
Field_River_Tot_PCBs_flds1
Field_River_Tot_PCBs
Field_River
Lab_Data_Tot_PCBs
Locations
Lab_Data
Field_Banks
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pl2_fldpl_poly_union2shp
pl2_river_poly_union
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10
12780405.322 343532.725 Feet

0-2” DWA interval

2-6” DWA interval

6-12” DWA interval

Mass Volume Report

Summary

MASS-VOLUME REPORT

Raster Layers:

Grid: 0_2nn2ft_clp : Source = D:\gis\projects\fields\Kalamazoo\samplepts\ARCADIS\SRI_Area_1_Phase_2\Plainwell_No_2_Dam_Area\john_shapefiles\0_2nn2ft_clp
Grid: 2_6nn2ft_clp : Source = D:\gis\projects\fields\Kalamazoo\samplepts\ARCADIS\SRI_Area_1_Phase_2\Plainwell_No_2_Dam_Area\john_shapefiles\2_6nn2ft_clp
Grid: 6_12nn2ft_clp : Source =

Name	Top Depth (inches)	Bottom Depth (inches)	Min. Conc.	Max. Conc.	Density (lb/yd3)	Vol (cu yd)	Mass (lb)	Vol (cu m)	Mass (kg)
0_2nn2ft_clp	0	2	0	0.999	2500	5,044.83950	4.32088	3,857.05655	1.95992
0_2nn2ft_clp	0	2	1	4.999	2500	2,982.93827	14.88688	2,280.61994	6.75257
0_2nn2ft_clp	0	2	5	9.999	2500	522.91358	9.53753	399.79612	4.32615
0_2nn2ft_clp	0	2	10	49.999	2500	1,135.92592	51.39004	868.47768	23.31013
0_2nn2ft_clp	0	2	50	100	2500	0.00000	0.00000	0.00000	0.00000
Subtotals:						9,686.61727	80.13532	7,405.95029	36.34877

2_6nn2ft_clp	2	6	0	0.999	2500	11,150.46912	8.72321	8,525.14534	3.95678
2_6nn2ft_clp	2	6	1	4.999	2500	5,959.16049	36.18317	4,556.10510	16.41241
2_6nn2ft_clp	2	6	5	9.999	2500	1,482.17284	26.47673	1,133.20244	12.00964
2_6nn2ft_clp	2	6	10	49.999	2500	777.72839	34.45635	594.61602	15.62914
2_6nn2ft_clp	2	6	50	100	2500	2.56790	0.41234	1.96330	0.18704
Subtotals:						19,372.09875	106.25180	14,811.03221	48.19501

6_12nn2ft_clp	6	12	0	0.999	2500	27,522.74071	16.40625	21,042.64512	7.44175
6_12nn2ft_clp	6	12	1	4.999	2500	1,489.18518	5.40041	1,138.56377	2.44958
6_12nn2ft_clp	6	12	5	9.999	2500	34.74074	0.60317	26.56120	0.27359
6_12nn2ft_clp	6	12	10	49.999	2500	5.48148	0.17912	4.19089	0.08125
6_12nn2ft_clp	6	12	50	100	2500	0.00000	0.00000	0.00000	0.00000
Subtotals:						29,052.14812	22.58895	22,211.96098	10.24618

GRAND TOTALS:						58,110.86414	208.97608	44,428.94348	94.78995

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